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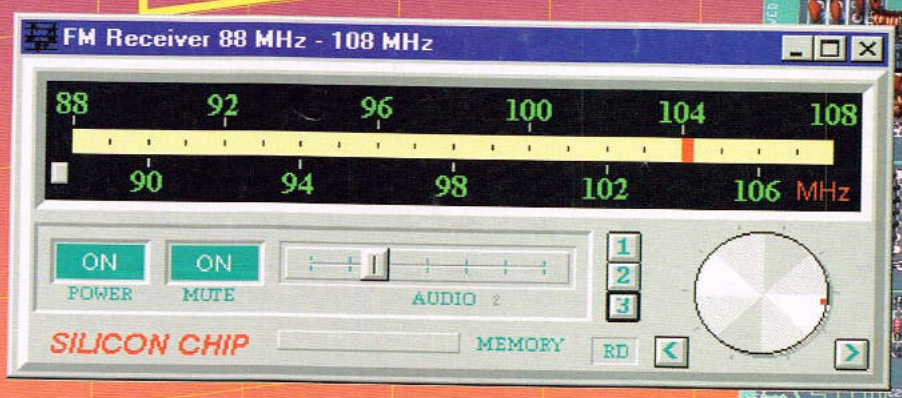

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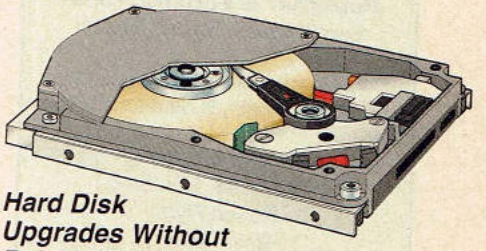

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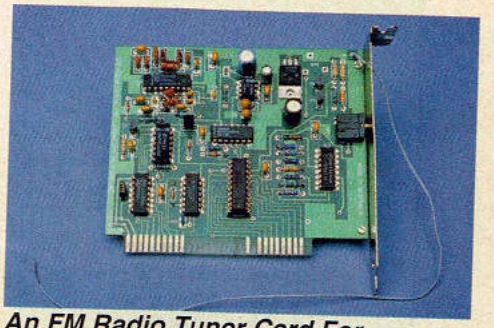

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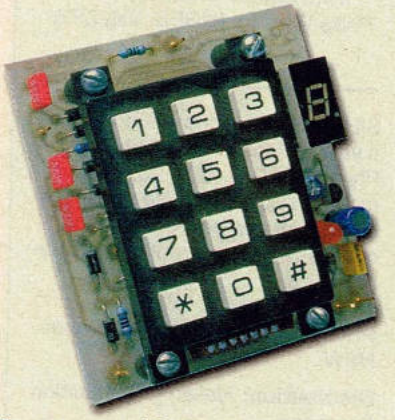

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PUBLISHER'S LETTER

Graphite bomb is too clever by half

Just recently, in the conflict in the Balkans, we've heard of a new "graphite" bomb which has been used to temporarily disable the electrical grid. NATO spokespersons trumpeted the new bomb as a breakthrough, saying that they "have their fingers on the switch" and can take out the power at any time without doing permanent damage to the country's infrastructure. Well, I just wonder about that.

Supposedly, the new bomb is detonated above the high voltage switchyard for a power station or for a major substation. The bomb produces a dense cloud of graphite several hundred metres wide and this proceeds to short out all the high voltage switchgear in the area and the power station or substation is then off the air. No major damage is done but the effect is to immediately disable the power grid and hence prevent military activities that would otherwise occur.

There seem to be several holes in this story. First, I can't imagine how a dense graphite cloud propagated by a major explosion over a high voltage switchyard would only cause temporary disablement. As far as I can see, it could well put the respective power station or substation completely out of commission. Just imagine – everything in the yard, high voltage fuses, insulators, switchgear – all of it would have graphite forced into every nook and cranny. How would you clean it out? It would not be simply a matter of washing everything down with a high pressure hose; graphite is not easy stuff to clean off.

No, the chances are that the graphite would well and truly permeate the surface of all insulators and switchgear. In fact, if all the fuses did not let go immediately, it is quite likely that all the graphite could provide the basis of a major fire. So it is possible that a great deal of the installation would have to be replaced, or if not, all of it would have to be painstakingly disassembled, cleaned and checked before it was put back into commission.

In peacetime such a re-commissioning of a large switchyard would probably take months and cost millions of dollars. In a country on a wartime footing, it is not likely that such damaged switchyards could be properly recommissioned until long after the cessation of hostilities. So NATO doesn't simply have their finger "on the switch" – they've done a great deal more harm than that. It is also arguable whether they have stopped any military activities by killing the power.

No, it seems to me that the graphite bomb is another example of technical overkill. Is this just technology for technologies' sake? Surely, if the desired result is to temporarily disable the grid, all that needs to be done is to take out a few of the high voltage transmission towers. You don't need a high-tech bomb for that.

Leo Simpson

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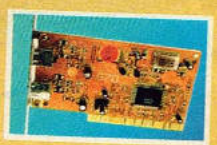

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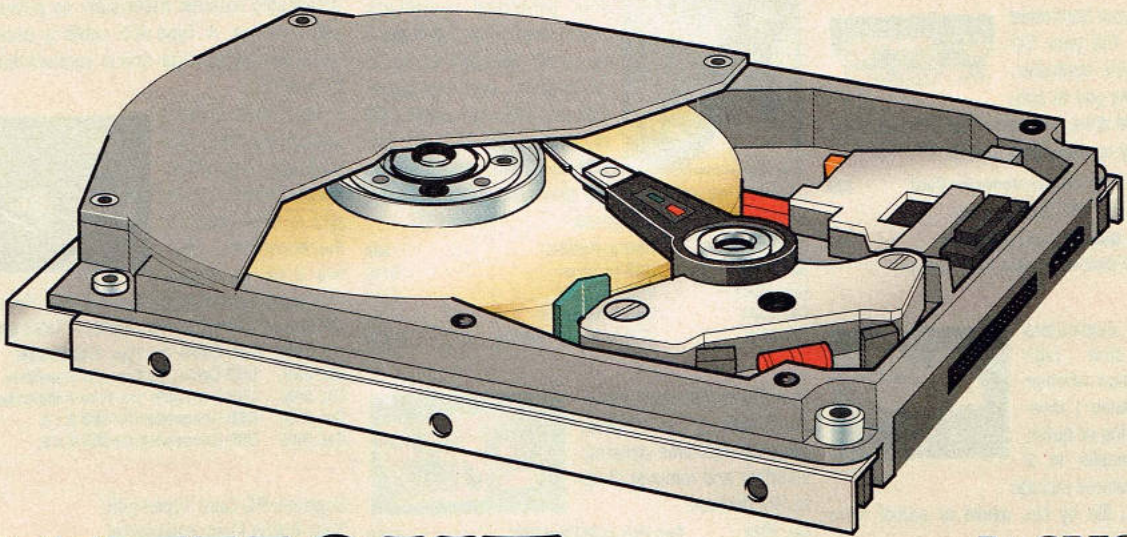
**Run out of room on your hard disk drive?
Want to upgrade to a bigger one?
Here's how to do it without the software hassles.**

Hard Disk Upgrades . . .



WITHOUT reinstalling software

By GREG SWAIN

THE HARD DISK DRIVE that came with your new PC might have seemed pretty big a couple of years ago but it's surprising how quickly it can fill up.

Both applications and operating systems are growing in size all the time, so it doesn't take long for hard disk space to disappear, particularly if you like downloading huge files off the net or storing music or video files.

Not too long ago, a 1.6-2GB drive was the standard but these are now considered modest compared to today's monsters. And as disk sizes have grown, the prices have come down. A typical 4.3GB drive can be picked up for about $240, while a 6.4GB drive will set you back around $290. The latter is clearly the better buy if you can afford it.

You need space!

A hard disk that's almost full not only prevents you from adding extra applications and files but can seriously degrade system performance as well.

There are two main reasons for this. First, the space that can be devoted to virtual memory, so that system RAM can be freed for other tasks, shrinks dramatically. Second, you can literally run out of room to store the temporary files that are created by Windows 95/98 applications as you work. As a result, your work grinds to a halt with frequent "out of memory" or "disk full" error messages.

Installation options

There are several options when it comes to installing a new hard disk drive into your PC. Most people take the easy path and simply add the new drive as drive D.

Assuming that the motherboard has at least two IDE ports (primary and secondary), the new drive can either be slaved with the first (ie, connected to the same port) or installed as a secondary drive on the second port.

Typically, this involves setting the jumpers on the back of the drive to

configure it as a master or slave, according to the drive manufacturer's instructions. On newer drives, the various jumper configurations are also usually shown on the label attached to the top of the drive.

Once the new drive has been recognised by the system BIOS, it is then partitioned and formatted in the usual manner.

The big advantage of this scheme is that you don't have to reinstall any software. After all, it's a real hassle to reinstall the operating system and all the applications, then download and reapply any patches or upgrades.

And that's before you even move your work files across. It can take many hours of work before your system is up and running again.

But what if you simply want to replace your existing C drive with the new drive?

There are several reasons why you may want to do this. First, the new drive is likely to be faster than the old drive, so making it the boot disk will give you better performance. Second, you might want to remove the existing drive altogether and use it to beef up capacity in another machine.

So is there an easy way to transfer everything, including the operating system, from the existing drive to the new drive and then make the latter the boot drive under Windows 95/98?

The answer is "yes" and the method is really quite straightforward.

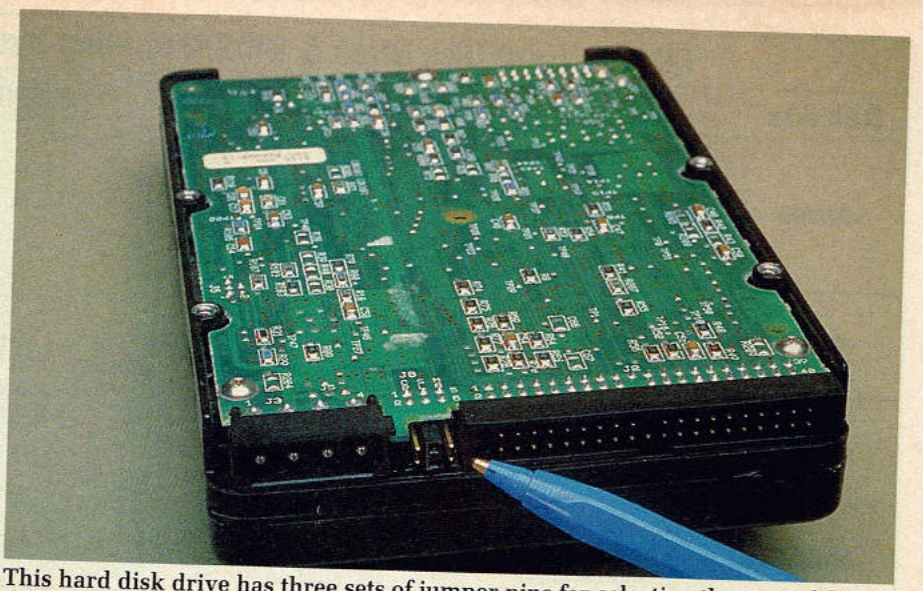
The following procedure has been gleaned from several sources on the net and worked perfectly when tried on a couple of test computers. It assumes the use of EIDE drives and Windows 95/98 and should work in virtually all cases although, as with most things to do with computers, there are no absolute guarantees.

What you have to do is first install the new drive as drive D, partition and format it, and then copy across all the files from the existing C drive. You then reconfigure the new drive so that it becomes the master (C:) drive, change the CMOS settings so that the drive is recognised and then make the primary partition the active partition.

It sounds easy when we say it quickly, doesn't it? OK, let's describe the procedure in a little more detail.

Installing the new drive

The first step, as we've said, is to install the new drive as a slave or secondary drive, so that it becomes drive D. There are a couple of things to watch out for here.



This hard disk drive has three sets of jumper pins for selecting the type of drive (master or slave) and these are located between the I/O cable socket and the power socket. In this case, the drive is jumpered as a slave (SL); the master (MA) jumper is to its right. The third pair of jumper pins is labelled CS, which is for a special "cable select" IDE connection cable (see panel).

First, if you intend connecting the new drive to the same IDE port as the existing C drive, it must be configured as a slave.

Second, check the jumper options for the existing C drive. On some drives, you will need to alter the jumpers to change from a single (drive used on its own) configuration to a master configuration. On other drives, the two configurations have the same jumper settings.

If the new drive is used on its own on the secondary IDE port, it must be set to the single drive (or master) configuration. But if there's already a ZIP drive or CD-ROM drive (or any other drive) on this port, be sure to configure one as a master and the other as a slave.

Once the new drive is in, turn the PC on and load the CMOS setup program (on most PCs, press Del as it does its memory check).

You now have to load the new drive's settings into the system BIOS at the Drive D line. In most cases, all you have to do is set the drive type to "Auto" (for auto-detect) and the mode to "LBA" (logical block addressing), leaving all other fields blank.

This will allow the computer to automatically detect the drive and determine its settings. If your system BIOS doesn't support auto detect and LBA, you will have to manually enter the number of cylinders, heads and sectors per track into the appropriate fields.

BIOS disk limits

It's here that you may run into BIOS limitation problems. Many older BIOSes, particularly on 486 (and lesser) machines, are unable to recognise disk sizes above 528MB, while some BIOSes cannot recognise disk sizes beyond 2.1GB or 3.27GB. In addition, many recent BIOSes cannot recognise disk sizes larger than 8.4GB.

One way around this problem is to use a BIOS translation program such as Ontrack's Disk Manager. Sometimes, this software will be supplied with the new disk drive. If not, it can usually be downloaded from the drive manufacturer's web site.

Western Digital, for example, have a utility called EZ-Drive (available from www.wdc.com/support). This utility allows you to correctly partition and format a Western Digital drive, so that your system BIOS recognises its full capacity.

Another way around the problem is to get a BIOS upgrade from the PC's manufacturer or from the motherboard manufacturer (check their web sites). Yet another option is to upgrade the motherboard.

We'll assume here that your BIOS supports auto detect and LBA, and that the drive is correctly recognised.

Table 1: Hard Disk Sizes & BIOS/Operating System Limitations

Disk Size	BIOS Issues	Windows 95a	Windows 95b/98	Windows NT
>528MB	Older BIOSes do not recognise drives bigger than 528MB. Requires the use of BIOS translating software (eg, Ontrack's Disk Manager).		Supports FAT32 partitions. Large hard disk drives can be partitioned and formatted as a single drive, provided there are no BIOS limitations.	
>2.1GB	Some BIOSes do not recognise partitions greater than 2.1GB.	FAT16 partitions are limited to 2.1GB. Drives larger than 2.1GB require multiple partitions.		FAT16 partitions are limited to 2.1GB.
>4.3GB		FAT16 partitions are limited to 2.1GB. Drives larger than 2.1GB require multiple partitions.		FAT16 partitions are limited to 2.1GB. An NTFS boot partition is limited to 4.2GB. NTFS partitions other than the boot partition can be greater than 4.2GB.
>8.4GB	Most BIOSes don't recognise partitions greater than 8.4GB.	FAT16 partitions are limited to 2.1GB. Drives larger than 2.1GB require multiple partitions.		

When you enter the information for the new drive (or allow the computer to auto detect it), make a note of the settings for both the existing drive and the new drive (just in case!), then save and exit the CMOS setup.

Partitioning & formatting

The next step is to partition and format the new drive. To do this, load Windows 95/98, then restart the computer in MS-DOS mode (click Start, Shut Down, select "Restart the computer in MS-DOS mode?" and click Yes).

Now, at the DOS prompt, enter *fdisk* and follow the on-screen menus to partition the new drive.

It's absolutely vital here that you first choose option 5 (Change Current Fixed Disk Drive) and specify the drive that you want to partition (ie, the new drive). If you only previously had one hard disk drive, the new drive becomes drive 2 and this is the one to specify. Don't attempt to repartition your current drive (drive 1). If you do, you will erase the contents of the disk and that's just what you *don't* want.

Having selected the new drive for partitioning, select menu option 1 to create a primary DOS partition. The maximum partition size that can be created depends on your operating system, so you may also have to create extended partitions to access the full capacity of the disk.

Windows 95a uses the FAT16 file system, which limits partition sizes to 2.1GB. This means that if you are partitioning a 4.3GB drive, you would have to make two partitions: a primary DOS partition of 2.1GB and an extended DOS partition also of 2.1GB. You can, of course, divide the drive into smaller partitions if you wish but note that you must create a primary DOS partition, otherwise the drive will not boot.

By contrast, Windows 95b and Windows 98 both support the FAT32 file system. This means that you can partition and format even the largest hard disks as a single drive (in theory, up to two terabytes, or 2TB).

Another advantage of FAT32 is that it uses much smaller cluster sizes than FAT16 and this saves hard disk space.

Provided you have Windows 95b or Windows 98, it's quite easy to create a FAT32 partition – just type *fdisk* at the DOS prompt and answer "Y" to the on-screen prompt "Do you wish to enable large disk support? Y or N".

You then select the new fixed disk and create a primary DOS partition in exactly the same manner as for a FAT16 system.

Once the new disk has been parti-

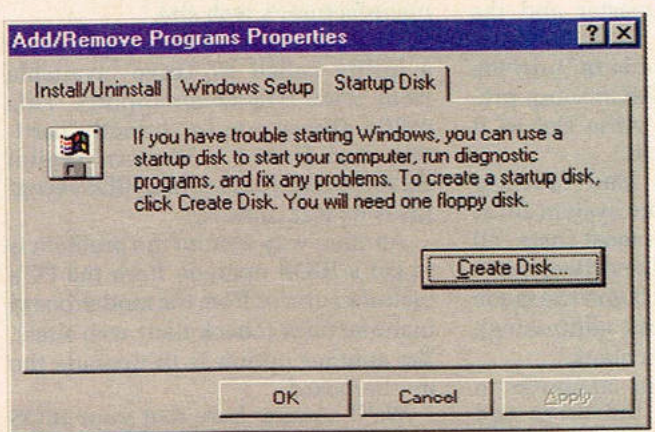

Add/Remove Programs Properties
Install/Uninstall
Windows Setup
Startup Disk
If you have trouble starting Windows, you can use a startup disk to start your computer, run diagnostic programs, and fix any problems. To create a startup disk, click Create Disk. You will need one floppy disk.
Create Disk...
OK
Cancel
Apply

Fig.1: creating a Startup Disk. This is required for making the primary partition on the new drive the active partition.

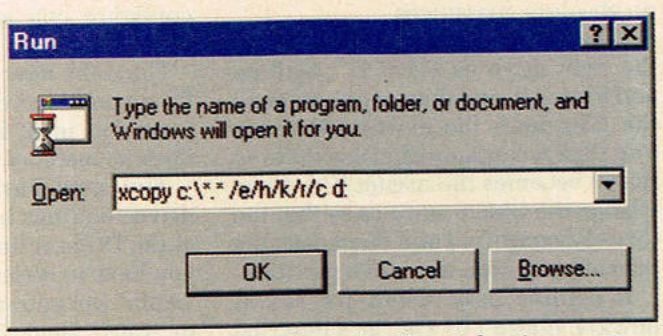


Fig.2: make sure that you include all switches in your xcopy command when copying across the files from the old drive to the new drive. By the way, the same command works for copying files between floppies or between a CD-ROM and a hard disk drive, ensuring you get all files including the hidden ones.

tioned it must be formatted. Reboot the computer (this must be done for the changes to take effect), return to MS-DOS mode and (at the DOS prompt) type:

```
format d:/s
```

This will format the new drive and copy across the system files to the primary DOS partition. If you have one or more extended partitions as well, these will have to be formatted separately (but without the /s switch) to provide the additional logical drives.

If the drive is formatted using EZ-Drive or similar software, you may have to transfer the system files to the new disk using the sys (system) command. To do this, type: sys d: and press <Enter>.

Creating a startup disk

You now have to create a Windows 95/98 Startup (boot) Disk. Allow Windows to load, then click Start, Settings, Control Panel and double-click the Add/Remove Programs icon.

Next, click the Startup Disk tab, then click the Create Disk button and follow the prompts – see Fig.1. Label the new Startup Disk and put it to one side. It will be used later on to boot the computer, after the drives are swapped.

Copying the files

Before copying the files across to the new drive, shut down all running applications. It's also a good idea to shut down (or disable) any utilities in your System Tray (at the righthand end of the Taskbar).

"CS" or Cable Select Jumpers

On most hard disk drives, you will find a pair of jumpers marked "CS". This stands for Cable Select and is a very handy way of automatically selecting which drive is the master and which the slave.

Cable Select uses a special hard disk connecting cable (standard IDE hard disk cables CANNOT be used). It looks similar but has the disk connectors clearly marked, sometimes drive 1 and drive 2; sometimes master and slave.

The drives are simply connected to the appropriate connectors. If you want to make your master the slave (and vice versa) you just swap the connectors over. It's that simple. So why is this simple system not used very much?

It could be because CS cables are not easy to obtain. But if you can find one, it makes life easy!

You're now ready to copy everything across from the C drive to the new D drive and to do this we use the xcopy command with a number of switches. To copy the files, click Start, Run and type:

```
xcopy c:\*.* /e/h/k/r/c d:
```

and click OK. This command instructs your system to copy all the files across, including:
(1) all subdirectories, even if they are empty (the /e switch)
(2) all files with hidden and system file attributes (/h); and
(3) all read-only files with the read-only attribute retained (/k/r). The /c switch instructs the system to ignore errors.

Depending on how many files you have on your existing hard disk, this operation could take quite some time.

Swapping the drives

Now shut down Windows 95/98, turn off the computer and change the jumper settings so that the new drive becomes the master drive. The old drive can either be removed or configured as the slave/secondary drive.

Next, insert the Startup Disk into the floppy drive, turn on the PC and edit the CMOS settings for the hard disk drives to reflect the changes just made. Save these settings, then continue booting with the Startup Disk.

If you find your computer fails to boot from the floppy disk, it may be that the CMOS setup has been told to boot from the C drive only. In this case, it will be necessary to edit the CMOS setup so that the system boots from a floppy disk.

You will find an option somewhere in the CMOS setup which allows you to select which drive the machine boots from.

Making the partition active

Once the machine has booted to the A: prompt, type *fdisk* (this utility will be on the Startup Disk) and select option 2 to make the primary partition on the new hard disk drive the active partition. Whatever you do, don't change the primary partition size or you will lose all information on the disk.

Next, exit fdisk, remove the floppy disk and reboot. Your system should now boot Windows 95/98 from the new hard disk. What's more, your system should be exactly the same as before, with all settings and applications intact.

Finally, if you were previously having problems with your system, the above procedure will copy those same problems to the new drive. If your system is corrupted, the best approach would be to use the new hard disk as an excuse for a fresh installation. **SC**

Variations

If you prefer, you can install the new disk as drive C first, then boot from a startup disk and run fdisk to partition it (making the primary active). It can then be formatted, after which you reinstall the old drive as C and configure the new drive as D before copying the files across.

The advantage of this method it that you only have to run fdisk once. The disadvantage is that more drive swapping is involved.

Another variation is to copy the files across using the Windows Explorer. Before doing this, you must first set the Explorer to show all files (click View, Options, Show all files), otherwise hidden/system files won't copy across. You must also configure the system so that the swap file is on the new D drive (go Control Panel, System, Performance, Virtual Memory, select "Let me choose my own virtual memory settings" and select the D drive).

Reboot so that the changes take effect, then click (C:) in the lefthand pane of the Windows Explorer, click Edit, Select All, Copy and paste it into the D drive. Finally, restore the original swap file setting (ie, "Let windows manage my virtual memory settings") when you boot from the new drive.

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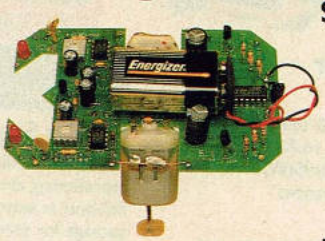

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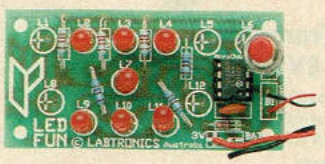

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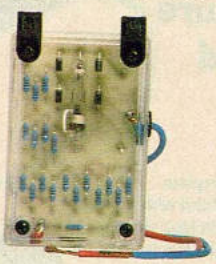

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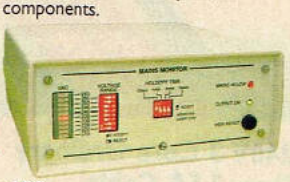

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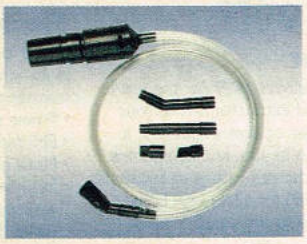

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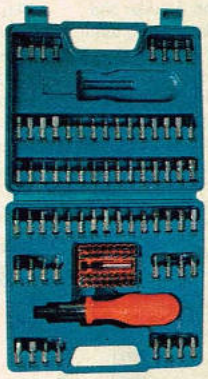

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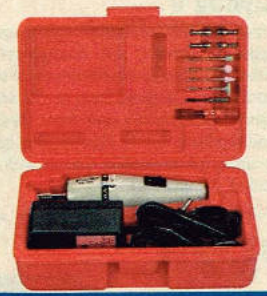

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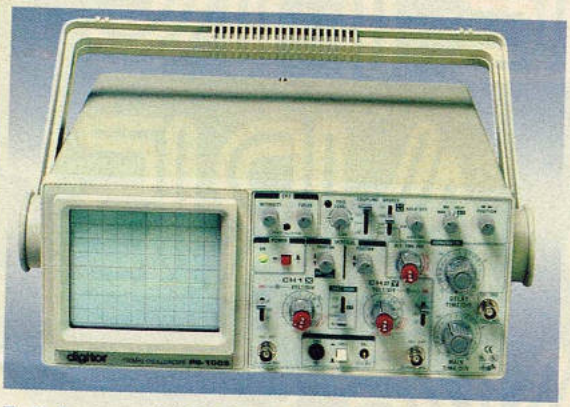

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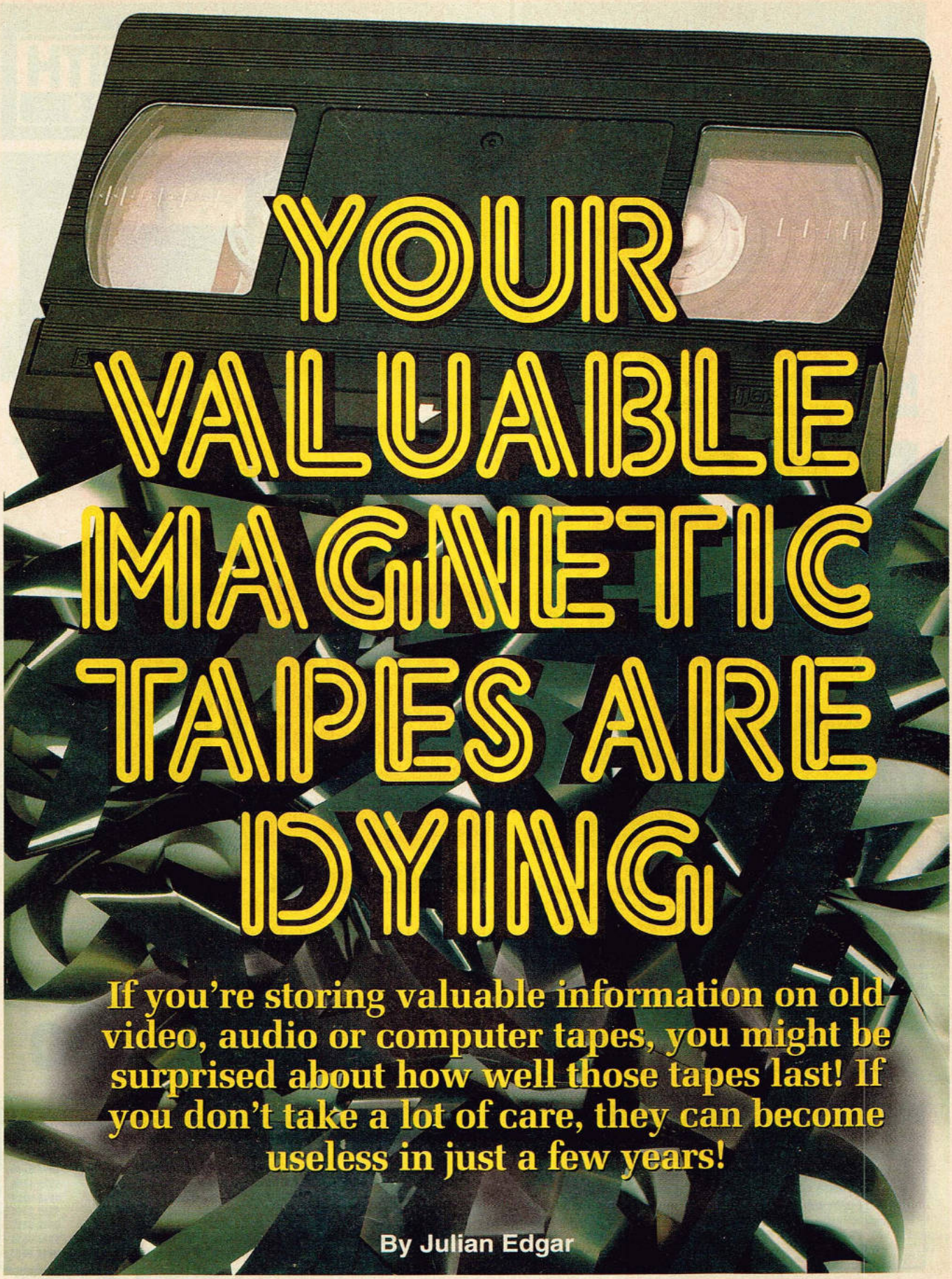

YOUR VALUABLE MAGNETIC TAPES ARE DYING

If you're storing valuable information on old video, audio or computer tapes, you might be surprised about how well those tapes last! If you don't take a lot of care, they can become useless in just a few years!

By Julian Edgar

WHILE MOST PEOPLE think of magnetic tape as a long-term storage medium, the actual length of time that the recorded information remains usable depends heavily on storage conditions and the quality of the tape. If you are not careful, tapes can deteriorate very rapidly.

But before we look at how you should be preserving your precious tapes, what exactly are the causes of tape degradation?

When a magnetic tape is recorded, the individual magnetic particles on the tape are oriented according to the influence of the recording head. Tiny bar magnets are created which have a length equal to a half wavelength at the frequency being recorded. These bar magnets are "hard" or permanent because of the coercive field strength of the magnetic material.

Strong external magnetic fields can alter the magnetic orientation of these particles. If that happens, the signal is degraded or lost. But with a few exceptions, such field strengths are comparatively rare. Even power lines with current flows of 1000A have no effect on magnetic tape recordings at a distance of more than one metre.

Standard household power wiring with current flows of up to 15A have a maximum resulting field strength of 0.16kA/m, which lies between 0.3-1% of the coercive field strengths of most common magnetic tapes. These fields therefore have no effect on magnetic tape. However, as can be seen in Fig.1, the distance from the magnetic field source to the tape is critical, so care should be taken that tapes aren't brought very close to the sources of magnetic fields.

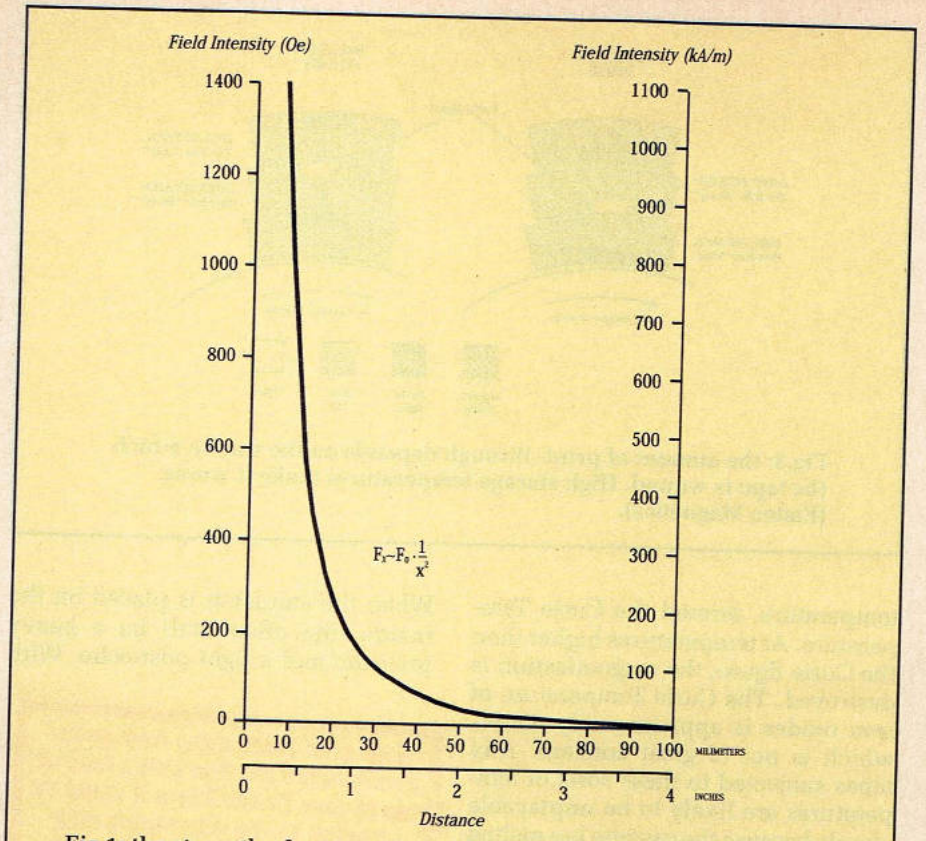

Fig.1: the strength of a magnetic field drops rapidly with increasing distance from its source. This means that magnetic tapes are generally quite safe from erasure if kept a reasonable distance away from such sources. (Emtec Magnetics – formerly BASF).

Keep away from magnets

Tapes should be kept away from strong permanent magnets, such as those in loudspeakers, dynamic headphones and microphones.

Also keep tapes away from power transformers and from motors in domestic appliances as these can produce quite strong magnetic fields at switch-on. Which appliances would these be? Vacuum cleaners, food processors and power tools are the main ones to watch. Of course, if you value your tapes, you wouldn't have them strewn around on the floor while you do the vacuuming, would you?

One particular trap which many people fall into is to put a video tape on top of their TV set. This is probably the worst place in your home for a video or audio tape.

Why? Because your tape is bound to be affected by the very strong magnetic field produced when the degaussing coil around the picture tube is momentarily energised at switch-on.

Security x-ray equipment in airports uses quite small field strengths, with a negligible effect on magnetic tape.

The presence of an external magnetic field during the actual recording process has a greater potential to affect the recording than during subsequent tape use and storage.

Curie temperature

The residual magnetism of recorded tape is stable only below a certain

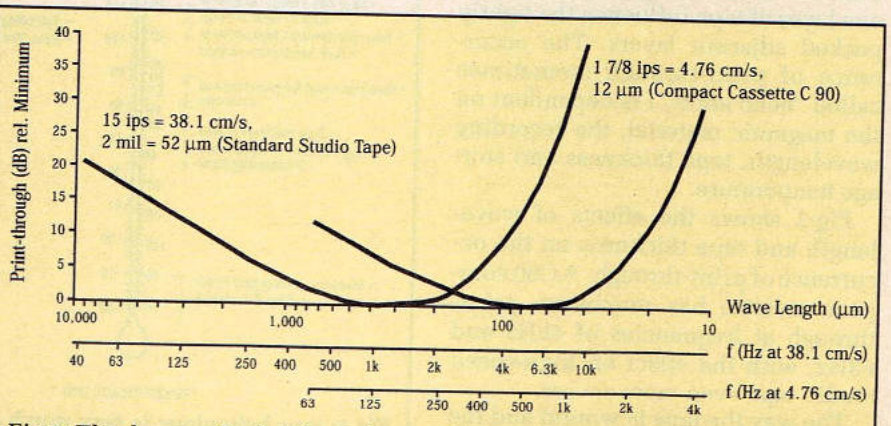

Fig.2: The degree of print-through and the frequencies affected depends on both the tape speed and the tape thickness. (Emtec Magnetics)

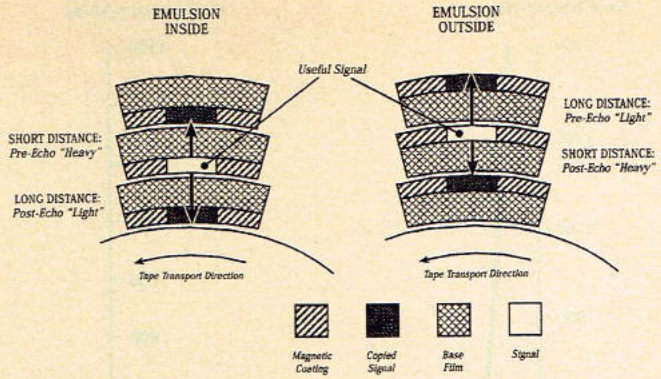

Fig.3: the amount of print- through depends on the way in which the tape is wound. High storage temperatures make it worse. (Emtec Magnetics).

temperature, termed the Curie Temperature. At temperatures higher than the Curie figure, the magnetisation is destroyed. The Curie Temperature of iron oxides is approximately 350°C, which is not of great concern. Any tapes subjected to these sorts of temperatures are likely to be unplayable simply because the cassette has melted or the tape itself has disintegrated!

The situation is different for chromium dioxide tapes. This material has a Curie temperature of close to 130°C. Such temperatures are possible in some circumstances of tape use, although again, a cassette exposed to this temperature is likely to be severely distorted and hence unplayable.

On the other hand, even extreme cold has no long term effect on magnetic tapes.

Print-through or echo

Another problem affecting stored magnetic tape is that of print-through. This is where the magnetic fields from one layer of tape influence the tightly packed adjacent layers. The occurrence of print-through (sometimes called "echo effect") is dependent on the magnetic material, the recording wavelength, tape thickness and storage temperature.

Fig.2 shows the effects of wavelength and tape thickness on the occurrence of print-through. A C90 compact cassette has maximum print-through at frequencies of 4kHz and 63Hz, with the effect on high-speed studio tape even more severe.

The way the tape is wound and the temperature at which it is stored will also affect the nature of print-through. When the emulsion is placed on the inside, the effect will be a heavy pre-echo and a light post-echo. With the tape wound so that the emulsion is on the outside, a light pre-echo and a heavy post-echo will occur. Fig.3 shows these effects. Print-through increases at higher temperatures.

Keep your tapes away from power transformers and don't sit a tape on top of your TV set where it could be affected by the very strong magnetic field when the degaussing coil around the picture tube is momentarily energised at switch-on.

The coercive strength of tapes depends on the size distribution of the magnetic particles used in their manufacture. Tapes with the most uniform particle size have the highest echo suppression ability.

Because print-through occurs without the aid of the high frequency bias recording signal, the simple mechanical stress of fast-forwarding and rewinding the tape can be enough to reduce the effect.

Print-through also occurs on digital and encoded recordings but because the spurious data is far beneath the signal recognition threshold, it can be ignored.

Repeated playing of tapes reduces the residual magnetisation of the tape. This effect is greatest after the first playback, with later losses progressively smaller. The final value is between 85-90% of the originally recorded signal amplitude.

In addition to the stability of the magnetisation of the tape, the magnetic particles themselves must be chemically stable if tape degradation is not to occur. Pure metal iron pigments or metal powders can oxidise readily if exposed to air and moisture. To prevent this happening, the iron particles are protected with a passivating coating of iron oxide, aluminium oxide and silicon dioxide. But as time passes, oxidation of the particles still results in a decrease in magnetic remanence.

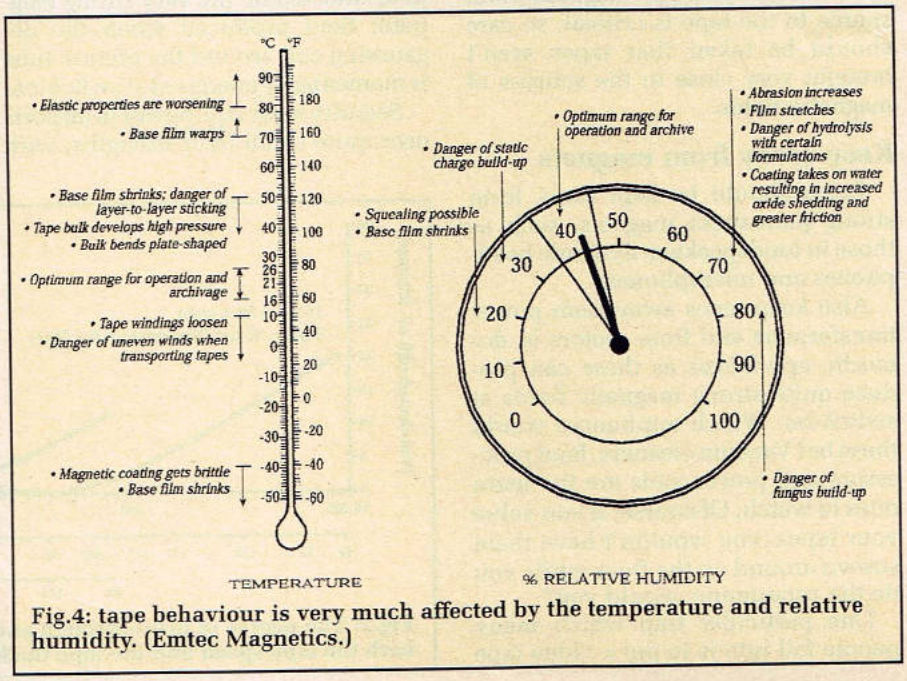
°C °F
• Elastic properties are worsening
• Base film warps
• Base film shrinks; danger of layer-to-layer sticking
• Tape bulk develops high pressure
• Bulk bends plate-shaped
• Optimum range for operation and archivage
• Tape windings loosen
• Danger of uneven winds when transporting tapes
• Magnetic coating gets brittle
• Base film shrinks
TEMPERATURE
• Danger of static charge build-up
• Optimum range for operation and archive
• Abrasion increases
• Film stretches
• Danger of hydrolysis with certain formulations
• Coating takes on water resulting in increased oxide shedding and greater friction
• Squealing possible
• Base film shrinks
• Danger of fungus build-up
% RELATIVE HUMIDITY

Fig.4: tape behaviour is very much affected by the temperature and relative humidity. (Emtec Magnetics.)

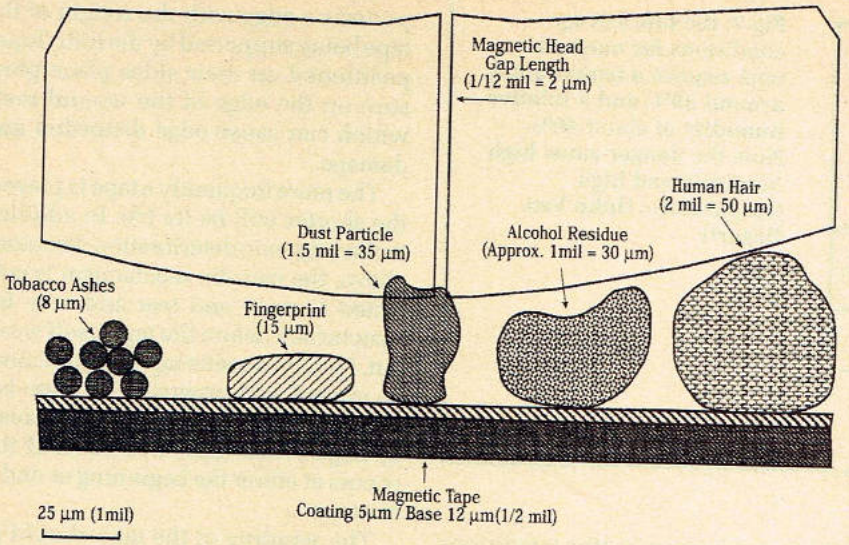

Fig.5: airborne dirt assumes huge proportions when examined in the size context of the audio tape system. (Emtec Magnetics).

Chromium dioxide particles are also subject to oxidation, converting to the more stable oxide forms which are non-magnetic. Thus, magnetic remanence of these tapes also decreases with time. "Metal" tapes do not use conventional binder technology. Instead, they have a continuous, thin layer of metal alloy deposited onto a base film. This alloy is subject to oxidation and over time, again a decrease in magnetic remanence can be observed. Polluting gases in the atmosphere can act as a catalyst for this oxidisation.

As Fig.3 shows, magnetic tape uses a base film to provide the physical strength, and a binding agent is used to tie the magnetic particles to the base film. The binding agent serves several other purposes.

First, it provides a smooth surface for the tape which would otherwise be as rough as sandpaper. Second and third, it acts as a lubricant and head-cleaning agent and finally, the binder contains carbon black to reduce static charges that would otherwise attract debris to the tape.

Shelf life

The shelf life of magnetic tape is controlled by the durability of the binder, rather than the magnetic particles or the base film.

Binders can deteriorate through softening, embrittlement, loss of cohesion or loss of lubrication.

Binder polymers are subject to hydrolysis, whereby the polyester linkages in the commonly used polyurethane-based binder systems are broken down through reaction to water in the air. This process can also release organic acids which accelerate the rate of hydrolytic decomposition.

The acids also attack and degrade the magnetic particles. Tape binder debris released through hydrolytic processes will cause drop-outs on a VHS tape being played back and squealing of sticky audio tapes. This degradation process can sometimes be temporarily overcome if the tapes are baked in an oven to drive off the excess moisture. The tapes should then be quickly transcribed before they revert to their old ways!

The lubricant in magnetic tapes is contained within pores in the surface of the tape. When the tape passes over the head or guide, lubricant is squeezed out, thus easing the passage of the tape. Excess lubricant is absorbed back into the tape once it has moved on, although some lubricant is always sacrificed each time the tape is played. Lubricant is left on the head and guide pins and some evaporates into the atmosphere. When lubricant levels are very low, the tape can be restored by being re-lubricated.

Acetate base

Audio tapes manufactured in the 1940s and 1950s used acetate as the base. One way of determining if a tape is of this type is to hold it up to the light. If light can be seen coming through the tape windings, an acetate base has been used. Degradation of the backing of these tapes can be indicated by an odour of vinegar and the tape may become brittle and break easily if bent sharply or tugged. Note

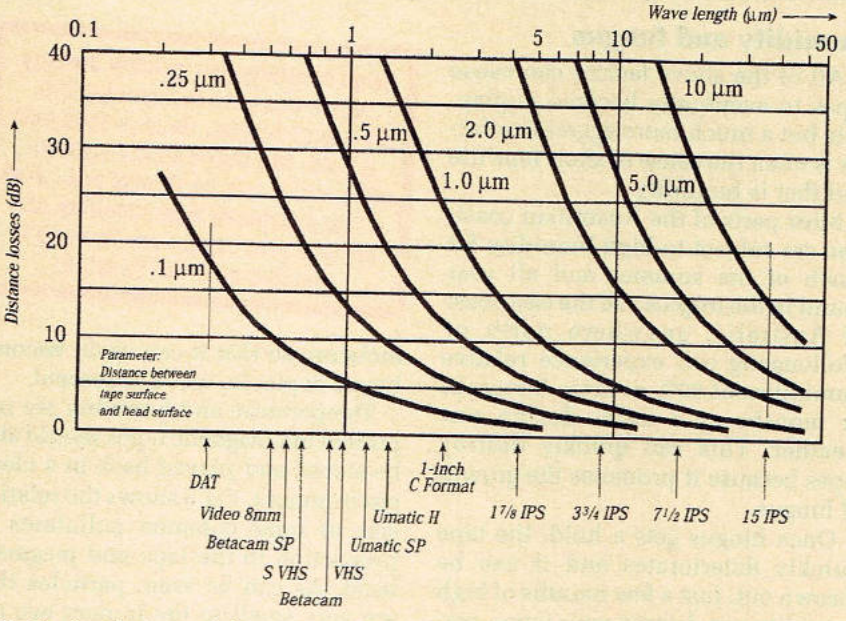

Fig.6: signal strength loss, as the distance between the tape surface and the head increases, depends on the frequency concerned and the tape format. (Emtec Magnetics.)

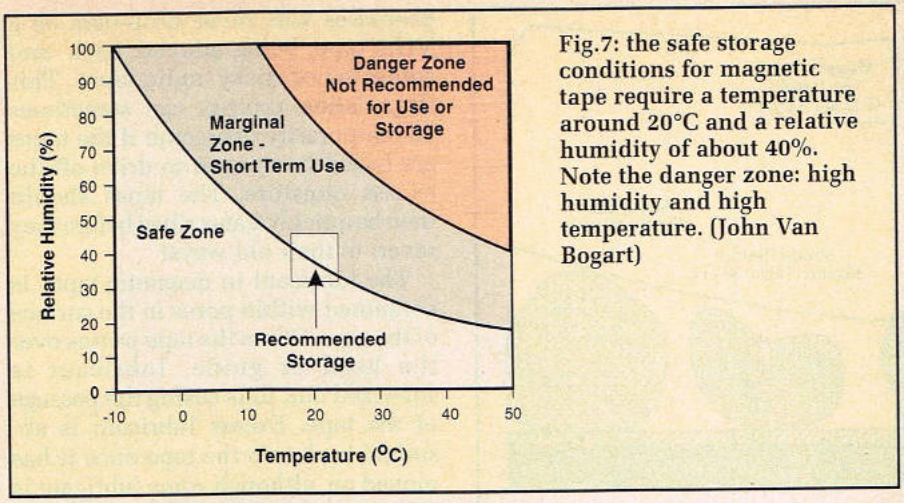

Fig.7: the safe storage conditions for magnetic tape require a temperature around 20°C and a relative humidity of about 40%. Note the danger zone: high humidity and high temperature. (John Van Bogart)

that tapes of this kind can degrade quite suddenly, with 50-year old tapes becoming unplayable over just a few years. Tapes degraded to the "vinegar" stage should be stored separately to tapes still in good condition.

Since the 1960s, audio and video tapes have used oriented polyester (polyethylene terephthalate or Mylar) as a base. This material is generally very stable, with the tape backing outlasting the binder in practical situations. The only problems with polyester-backed videotapes is that excessive tape winding stress can result in distortions and subsequent tape mistracking and that large changes in temperature can cause the backing to become dimensionally unstable.

Humidity and fungus

All of the above factors can cause tapes to eventually become unplayable but a much more aggressive factor is often the cause of short tape life and that is humidity.

Most parts of the Australian coastline are subject to high humidity for much of the summer and all year round in the tropics. On the east coast of Australia, anywhere north of Wollongong can experience relative humidities of 80% or more for weeks or months at a time, during wet weather. This can quickly destroy tapes because it promotes the growth of fungus.

Once fungus gets a hold, the tape quickly deteriorates and it can be thrown out. Just a few months of high humidity can destroy your tapes, particularly if you live near the seaside.

Preserving magnetic tapes

As one expert put it "the conditions which are good for you are also good for magnetic tape storage". This means that temperatures of about 18-21°C and a relative humidity of no more than 40-50% will give the longest tape life. Fig.4 shows the behaviour of magnetic tape across a range of temperature and relative humidity.

If you live in an area with high humidity, there is only one way to ensure that your tapes are not exposed to the risk of fungus. That is to store them in sealed containers along with a small bag of silica gel. From time to time, you need to check the silica gel so see if it has turned pink. If so, it needs to be baked in an oven set to a low temperature, to drive off all the moisture so that it can again become hygroscopic; ie, water absorbent.

High humidity can quickly destroy tapes because it promotes the growth of fungus. Once fungus gets a hold, the tape quickly deteriorates and it can be thrown out. Just a few months of high humidity can destroy your tapes, particularly if you live near the seaside.

Temperature and humidity are important but magnetic tapes should also be stored and played back in a clean environment. Fig.5 shows the relative size of some common pollutants in proportion to the tape and magnetic head. As can be seen, particles that are very small to the human eye are significantly larger when considered within the context of magnetic tape recording technology!

Tapes should be stored and transported on edge with the weight of the tape being supported by the hub. Tapes positioned on their sides place pressure on the edge of the wound reels which can cause edge distortion and damage.

The more frequently a tape is played, the shorter will be its life. In addition to the magnetic deterioration discussed above, the cassette mechanism is subjected to wear and tear and may fail structurally before the tape itself wears out. Ideally, cassette tapes should never be ejected mid-program – if there is a problem with the ejection that causes damage to the tape, it is better if this occurs at either the beginning or end of the tape.

The winding of the tape should always be carried out on equipment that maintains a constant tension at low speed.

Library wind mode

Libraries storing archival magnetic tapes use special equipment that provides a "Library Wind Mode" to give a predetermined winding speed and tension. In normal domestic use, equipment should be maintained in mechanically good condition.

Tapes should be stored in a "tail out" condition, with the program end on the outside of the spool. Rewinding the tape prior to playing will then reduce print-through. Some experts recommend tape "refreshing" on a periodic basis.

This means that the tape should be unspooled and rewound at intervals of about three years to redistribute tape stress and prevent tape pack slip.

Care should be taken that the surface of the tape does not become contaminated by fingerprints or dust. Any surface contamination that increases the distance from the playing head to the tape results in a reduction in signal strength.

The frequencies which are most affected are dependent on the distance and the format of the tape recording. The potential for information loss is far greater on formats where the information density is highest. Fig.6 shows this.

Storage temperatures

Storage at temperatures over 23°C increases tape pack tightness, resulting in distortion of the tape backing and an increase in permanent drop-

outs as wound-in debris is forced into the magnetic layer. This deformation of the magnetic layer can also affect adjoining windings.

Layer-to-layer adhesion can also occur if the tape is stored at higher temperatures. Fig.7 shows the recommended storage conditions for magnetic tapes.

When tapes are transferred from cool, dry storage conditions to normal environments, time should be given for the tape to "acclimatise". A compact audio cassette should be allowed an hour for temperature and six hours for relative humidity stabilisation. A VHS/Beta cassette can take up to four hours to become temperature stable and as long as eight days to settle in relative humidity.

How long do they last?

So how long will your magnetic tapes last, given good care? Magnetic tape is certainly not as stable as film or paper. Properly cared for, non-acidic paper can last for centuries but manufacturers' data sheets indicate that the life expectancy for video and audio tapes is about 30 years.

However, accelerated aging tests have indicated that high grade VHS video tape may have a life of only 10 years if stored in conditions with a relative humidity of 50% and a temperature of 22°C. This improves to 30 years at 30% relative humidity and 18°C. The very highest estimates of VHS tape life are in the region of 40 years, while the lowest are closer to five years.

And as we have said, if you have high humidity, the life of a tape may only be a few months!

The life expectancy of digital data tapes is more related to the long-term availability of hardware on which to play the tapes back than any other factor! With digital recording technology changing every 5-10 years, storing appropriate playback equipment should be seriously considered if the taped information isn't regularly dubbed to new media as the old becomes obsolete.

If the playback equipment remains available and the tapes have been stored correctly, digital tapes have been shown to have a long life.

One US government agency recently transcribed 20,000 10-year-old 3480 tape cartridges. Only two cartridges had unrecoverable errors. SC

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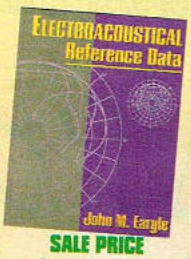

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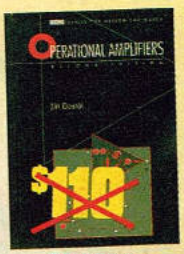

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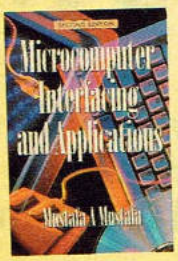

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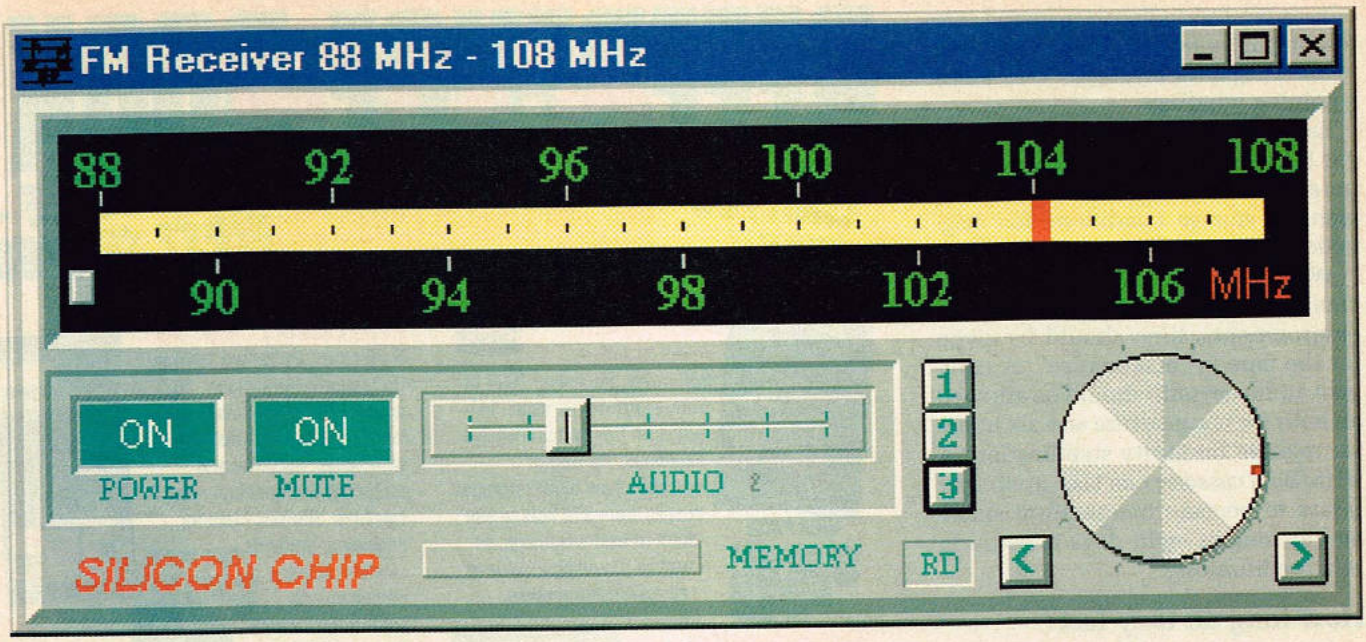


An FM Radio Tuner Card for your PC

Fancy an FM radio receiver inside your PC? This simple circuit plugs into a spare slot on your PC's motherboard and is tuned using an on-screen display.

Why on earth would you want to fit an FM receiver into your PC?

Well, why not? If you're the type who enjoys music while you work or while you take a break, this FM radio receiver is only a couple of mouse clicks away. It's a mono-only design but when you're working you're not likely to notice the difference, especially when using low-cost multimedia loudspeakers.

A PC-controlled FM receiver has several advantages. It's convenient to use, there are no batteries to go flat and, because it fits inside the PC and is software controlled, you don't have to worry about a case, a tuning knob or an external power supply.

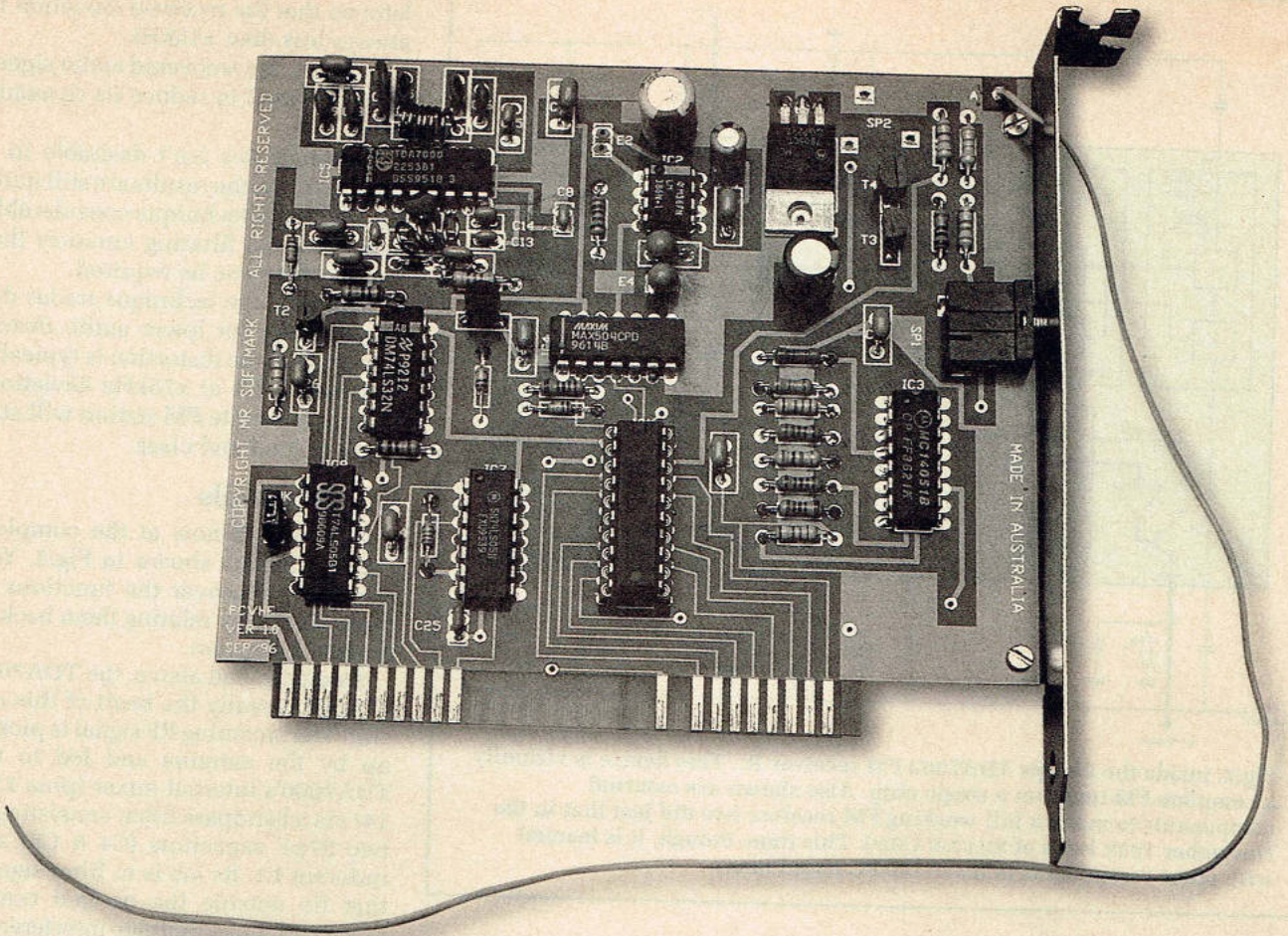
Unlike most other PC-controlled tuners, this circuit includes its own on-board audio amplifier and this is capable of driving a set of external speakers to good volume. In other words, this circuit operates independently of the sound card. This means that the sound card can be used for other purposes while the FM receiver is operating.

The circuitry for the PC FM Tuner

FEATURES

- Full 88-108MHz FM band coverage
- Fully self-contained on one ISA card
- Computer controlled via your screen
- 3 preset memories for your favourite FM stations
- Slider volume control
- Does not need a sound card – fully independent operation.

Design by MARK ROBERTS



The circuit is built on an ISA card which plugs into a spare slot on your PC's motherboard. Note that several changes were made to the PC board layout after this photo was taken.

is built on an expansion card and plugs into a standard ISA slot on the your PC's motherboard. A single on-board link sets the address to either 300H or 301H. Note that the card isn't Plug and Play (PnP), so if you have other non-PnP cards in your system you may have to manually juggle the resources to suit.

The screen grab on the facing page shows the display that's used to "drive" the FM tuner. There's really not much to it! The top half consists of a linear dial scale to show the tuned frequency (88-108MHz), while the bottom half carries the controls – an On/Off button, a Mute button, a volume control slider, three memory preset buttons and a tuning knob.

You tune the unit by dragging the tuning "knob" with the mouse, or you can click anywhere on the circumference of the knob to tune to that spot. Alternatively, you can tune the unit by clicking the up and down arrows.

In addition, up to three stations can be stored in memory by clicking the 'Memory' button (so that it displays 'WR') and then clicking one of the memory presets (1, 2 or 3). The receiver also "remembers" the last station it was tuned to when it was turned off.

Block diagram

Fig.1 shows the block diagram of the PC FM Tuner. It's built around a Philips TDA7000 FM radio IC, which

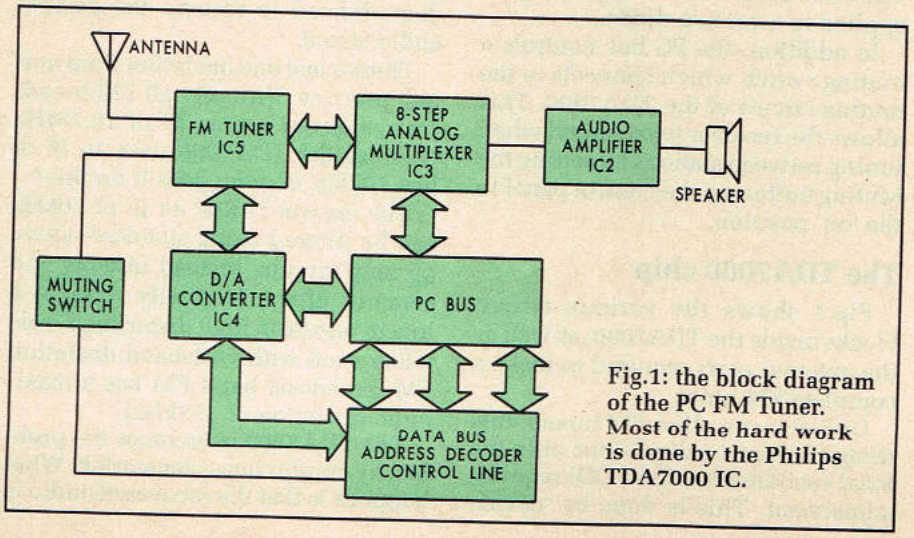


Fig.1: the block diagram of the PC FM Tuner. Most of the hard work is done by the Philips TDA7000 IC.

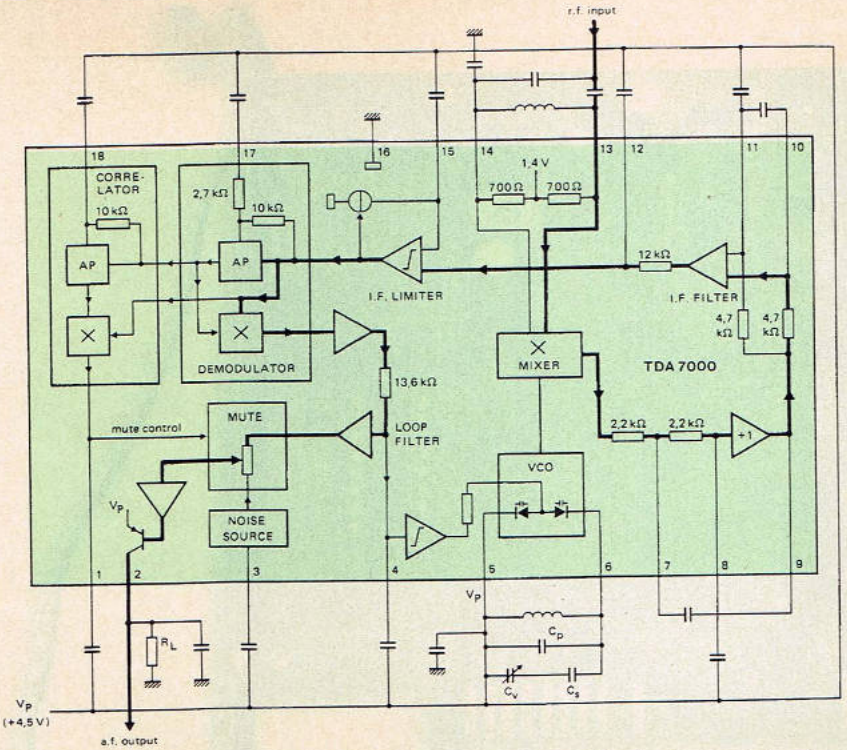


Fig.2: inside the Philips TDA7000 FM receiver IC. This device is virtually a complete FM tuner on a single chip. Also shown are external components to make a full working FM receiver (we did just that in the November 1992 issue of SILICON CHIP). This time, though, it is teamed with other components to make the PC-based tuner.

is virtually a complete FM radio on a single chip. It drives an LM386 audio amplifier stage via an 8-step analog multiplexer, the latter providing the volume control function.

The multiplexer is controlled by the data on the PC bus and this in turn is controlled by the software. The PC bus also controls a D/A converter stage to provide the tuning voltage to the TDA7000 chip. This tuning voltage is applied to a varicap diode.

In addition, the PC bus controls a muting switch which connects to the muting circuit of the TDA7000. This allows the receiver to be muted when tuning between stations by setting the Muting button on the control panel to the 'on' position.

The TDA7000 chip

Fig.2 shows the various circuit blocks inside the TDA7000, as well as the external parts required to make a complete FM tuner.

Unlike many other FM tuners, this design is easy to align since only the local oscillator (ie, the VCO) requires adjustment. This is done by 'tweaking' the coil across the VCO, so that the tuner covers the desired frequency range.

The TDA7000 IC more or less functions as a conventional superheterodyne tuner. This means that the incoming FM signal is mixed with a local oscillator signal (from the VCO) to produce an intermediate frequency (IF). This IF signal is then filtered to remove any mixer artefacts and then demodulated to recover the desired audio signal.

There's just one deviation from normal practice. Virtually all FM broadcast receivers use an IF of 10.7MHz whereas the TDA7000 uses an IF of just 70kHz. So why does it do this?

The answer is that an IF of 70kHz can be filtered using standard active op amp circuits instead of coils and ceramic filters. Normally though, a low IF results in high distortion levels when used with wideband deviation FM (broadcast band FM has a maximum deviation of ±75kHz).

The TDA7000 overcomes the problem by employing a clever trick. What happens is that the recovered audio is also used to modulate the local oscillator so that the received deviation is always less than ±15kHz.

In effect, the recovered audio signal is compressed to reduce its dynamic range.

Although this isn't desirable in a hifi FM tuner, the results are still quite good and this technique considerably simplifies the filtering circuitry that would otherwise be required.

Basically, the technique trades dynamic range for lower audio distortion. In fact, the distortion is typically less than 2.3% at ±75kHz deviation, so your favourite FM station will still come in loud and clear.

Circuit details

Take a look now at the complete circuit diagram shown in Fig.3. You can easily discover the functions of the main ICs by relating them back to the block diagram.

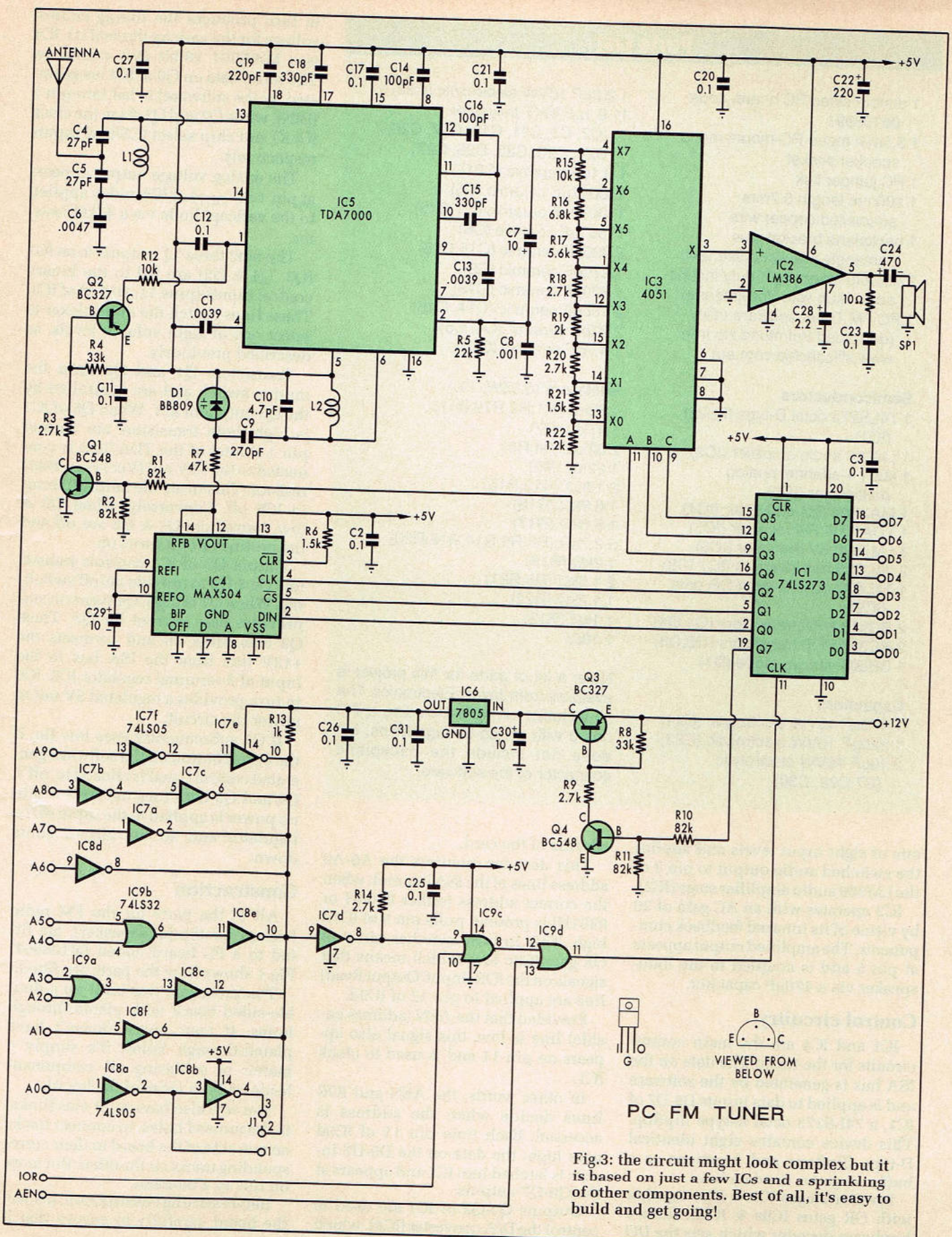
As mentioned above, the TDA7000 IC (IC5) is really the heart of this circuit. The incoming RF signal is picked up by the antenna and fed to the TDA7000's internal mixer (pins 13 & 14) via a bandpass filter, consisting of two 27pF capacitors (C4 & C5) and inductor L1. Its job is to filter signals that lie outside the desired tuning range and thus eliminate interference.

Varicap diode D1 and inductor L2 are used to tune IC5's internal voltage controlled oscillator (VCO) so that the receiver covers the FM broadcast band. The tuned frequency in turn depends on the voltage applied to D1, which varies its capacitance accordingly. This tuning voltage is derived from the D/A converter (IC4).

The recovered audio signal appears on pin 2 of IC5 and is fed via a low-pass filter (R5 & C8) to the top of a resistive divider network (R15-R22). The filter stage, in conjunction with the divider resistance, provides the necessary 50µs de-emphasis for the recovered audio signal.

The eight steps in this divider are in turn fed to the X0-X7 inputs of IC3, the 4051 analog multiplexer. This IC is controlled by the signals on its three binary control inputs, designated A, B & C (pins 11, 10 & 9). In operation, the three binary control signals select which of the eight input channels is switched through to the output at pin 3.

In essence, IC3 functions as a single-pole 8-position switch. It selects



PC FM TUNER

Fig.3: the circuit might look complex but it is based on just a few ICs and a sprinkling of other components. Best of all, it's easy to build and get going!

Parts List

1 double-sided PC board, code 06106991
1 3.5mm mono PC-mount mono speaker socket
1 PC jumper link
1 100mm length 0.7mm enamelled copper wire
1 backplane bracket plus rightangle brackets (see text)
2 750mm length light-duty insulated hookup wire (for antenna)
1 PC FM Tuner software utility (download Pcfmtune.zip from www.siliconchip.com.au)

Semiconductors
1 74LS273 octal D-type flipflop (IC1)
1 LM386 audio amplifier (IC2)
1 4051 4-channel analog multiplexer (IC3)
1 MAX504 D/A converter (IC4)
1 TDA7000 FM receiver (IC5)
1 LM7805 5V regulator (IC6)
2 74LS05 hex inverters (IC7,IC8)
1 74LS32 quad 2-input OR gate (IC9)
2 BC548 NPN transistors (Q1,Q4)
2 BC327 PNP transistors (Q2,Q3)
1 BB809 varicap diode (D1)

Capacitors
1 470µF 10VW electrolytic (C24)
1 220µF 16VW electrolytic (C22)
3 10µF 16VW electrolytic (C7,C29, C30)
1 2.2µF 16VW electrolytic (C28)
11 0.1µF MKT polyester (C2, C3, C11, C12, C17, C20, C21, C23, C25, C26, C27)
1 0.1µF ceramic (C31)
1 .0047µF ceramic (C6)
1 .0039µF ceramic (C1,C13)
1 .001µF ceramic (C8)
2 330pF ceramic (C15,C18)
1 270pF ceramic (C9)
1 220pF ceramic (C19)
2 100pF ceramic (C14, C16)
2 27pF ceramic (C4, C5)
1 4.7pF ceramic (C10)

Resistors (0.25W, 1%)
4 82kΩ (R1,R2,R10,R11)
1 47kΩ (R7)
2 33kΩ (R4,R8)
1 22kΩ (R5)
2 10kΩ (R12,R15)
1 6.8kΩ (R16)
1 5.6kΩ (R17)
5 2.7kΩ (R3,R9,R14,R18,R20)
1 2kΩ (R19)
2 1.5kΩ (R6,R21)
1 1.2kΩ (R22)
1 1kΩ (R13)
1 10Ω

Note: a kit of parts for this project is available from Jaycar Electronics. The kit includes all parts including a PC board with plated-through holes, but does not include the backplane connector or the software.

one of eight input levels and applies the switched audio output to pin 3 of the LM386 audio amplifier stage (IC2).

IC2 operates with an AC gain of 20 by virtue of its internal feedback components. The amplified output appears at pin 5 and is coupled to the loudspeaker via a 470µF capacitor.

Control circuitry

IC1 and IC4 are the main control circuits for the tuner. The data on the ISA bus is generated by the software and is applied to data inputs D0-D7 of IC1, a 74LS273 octal D-type flipflop. This device contains eight identical D-type flipflops and functions as a buffer stage for the data lines.

Inverter stages IC7 & IC8, together with OR gates IC9a & IC9b, form a hardware decoder which sets the I/O address of the card.

This decoder monitors the A0-A9 address lines of the ISA bus and, when the correct address (either 0300H or 0301H) is present, pulls pin 9 of IC7d high. This in turn switches pin 9 of OR gate IC9c low, which means that signals on the IOR (Input/Output Read) line are applied to pin 12 of IC9d.

Provided that the AEN (address enable) line is low, this signal also appears on pin 11 and is used to clock IC1.

In other words, the AEN and IOR lines decide when the address is accessed. Each time pin 11 of IC9d goes high, the data on the D0-D7 inputs is latched into IC1 and appears at the Q0-Q7 outputs.

Outputs Q0-Q2 of IC1 are used to control the D/A converter (IC4), which in turn produces the tuning control voltage for the varicap diode (D1). IC4 is a MAX504 10-bit D/A converter. The serial data on Q0 of IC1 (as generated by the software) is fed into pin 2 (DIN), while Q2 and Q1 drive the clock (CLK) and chip select (CS-bar) inputs respectively.

The analog voltage output appears at pin 12 (V_{OUT}) of IC4 and is applied to the varicap diode via a 47kΩ resistor.

The next three 'Q' outputs from IC1 (Q3, Q4 & Q5) are fed to the binary control inputs (pins 11, 10 & 9) of IC3. These lines switch the multiplexer to select one of eight volume levels, as described previously.

Transistors Q1 and Q2 form the muting switch and are controlled by the Q6 output of IC1. When Q6 of IC1 is high, both transistors are on and pin 1 (Mute) of the TDA7000 is connected to the +5V rail (Vcc) via a 10kΩ resistor. This turns the muting circuit in IC5 off. Conversely, when Q6 is low, transistors Q1 & Q2 are off and the muting circuit turns on.

Output Q7 of IC1 controls transistors Q4 & Q3 to provide on/off switching. When Q7 is high, Q4 turns on and provides base current for Q3. Thus, Q3 also turns on and connects the +12V line from the ISA bus to the input of 3-terminal regulator IC6. IC6 in turn provides a regulated 5V rail to power the circuit.

If Q7 subsequently goes low (ie, if the on/off button on the software-generated control panel is clicked to 'off'), Q4 and Q3 both turn off. As a result, no power is applied to the input of the regulator and so the circuit shuts down.

Construction

All of the parts for the FM radio (except for the loudspeaker), are fitted to a PC board coded 06106991. Fig.4 shows how the parts are fitted.

The prototype was built on a double-sided board with plated-through holes. If your board doesn't have plated-through holes, it's simply a matter of soldering all component leads on both sides of the board.

You will also have to fit vias (links) to the unused holes, to connect tracks on one side of the board to their corresponding tracks on the other. But more on this in a moment.

Before starting construction, inspect the board carefully to ensure that it

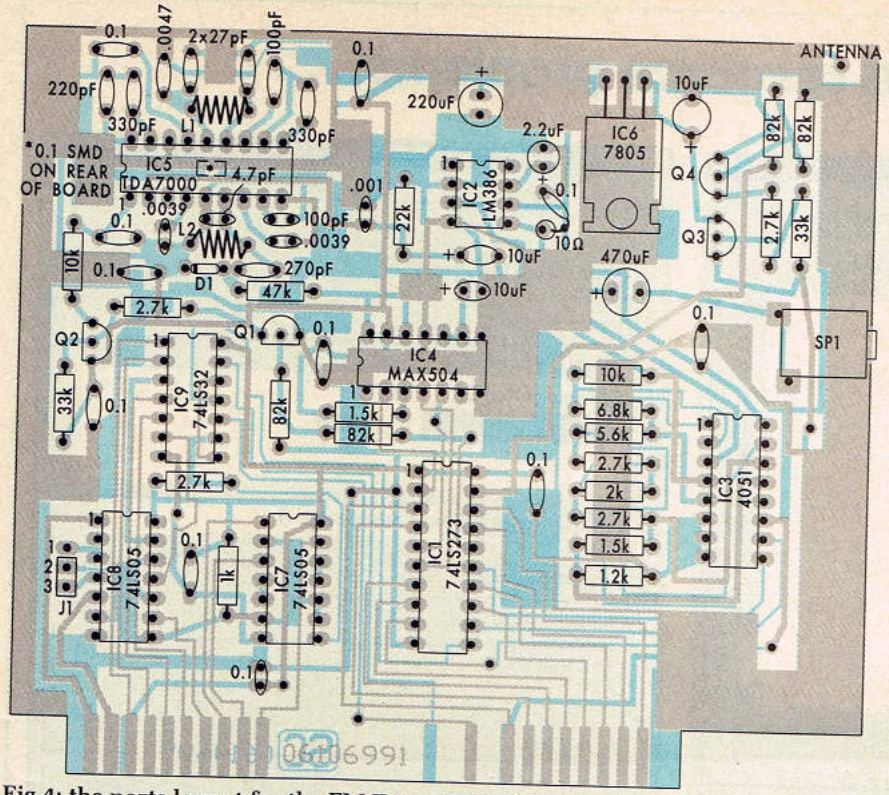


Fig.4: the parts layout for the FM Tuner Card. This is a double-sided PC board – the component side is shown in grey and the underside in blue. If you don't have a plated-through board, the points marked solely with a dot must be fitted with "pin throughs" (or vias) and you must solder the component leads on both sides of the board (see text).

has been correctly etched. This done, start the assembly by installing all the resistors, the capacitors and the ICs.

Table 1 shows the resistor colour codes, while Table 2 shows the codes for the MKT polyester and ceramic capacitors. It's also a good idea to check each resistor on a digital multimeter, just to make sure of its value.

Note particularly that a 0.1µF ceramic capacitor is installed on the copper side of the board, directly beneath IC1.

Keep all capacitor leads as short as possible and don't forget to solder all component leads on both sides if the board doesn't have plated-through holes (this includes the ICs).

All the ICs can be directly soldered to the PC board. Take care to ensure that they are all oriented correctly and don't get them mixed up.

Capacitor Codes

	Value	IEC Code	EIA Code
❑	0.1µF	100n	104
❑	.0047µF	4n7	472
❑	.0039µF	3n3	392
❑	.001µF	1n0	102
❑	330pF	330p	331
❑	270pF	270p	271
❑	220pF	220p	221
❑	100pF	100p	101
❑	27pF	27p	27
❑	4.7pF	4p7	4.7

Next, install the varicap diode (D1), the four transistors and the 3-terminal regulator. Once again, take care not to get the transistors mixed up and watch their orientation.

In particular, note that Q3 and Q4 face in opposite directions. The regulator is mounted with its leads bent at rightangles, as shown in the photo.

Now for the two inductors (L1 and L2). These are both made by winding 0.7mm enamelled copper wire (ECW) onto a 4mm former (eg, a 4mm drill bit). L1 consists of six closely-spaced turns, while L2 consists of five turns, evenly spaced to form a coil 8mm long (this coil is later adjusted during the alignment procedure).

After winding each coil, slide it off the drill bit, scrape away the enamel from its leads and push it all the way down onto the PC board before soldering.

The 3.5mm audio socket and the backplane bracket can now be installed. You can either make up a couple of rightangle brackets to attach the backplane bracket, or you can salvage

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	4	82kΩ	grey red orange brown	grey red black red brown
❑	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	2	33kΩ	orange orange orange brown	orange orange black red brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	2	10kΩ	brown black orange brown	brown black black red brown
❑	1	6.8kΩ	blue grey red brown	blue grey black brown brown
❑	1	5.6kΩ	green blue red brown	green blue black brown brown
❑	5	2.7kΩ	red violet red brown	red violet black brown brown
❑	1	2kΩ	red black red brown	red black black brown brown
❑	2	1.5kΩ	brown green red brown	brown green black brown brown
❑	1	1.2kΩ	brown red red brown	brown red black brown brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	1	10Ω	brown black black brown	brown black black gold brown

Sorting out I/O and resource problems . . .

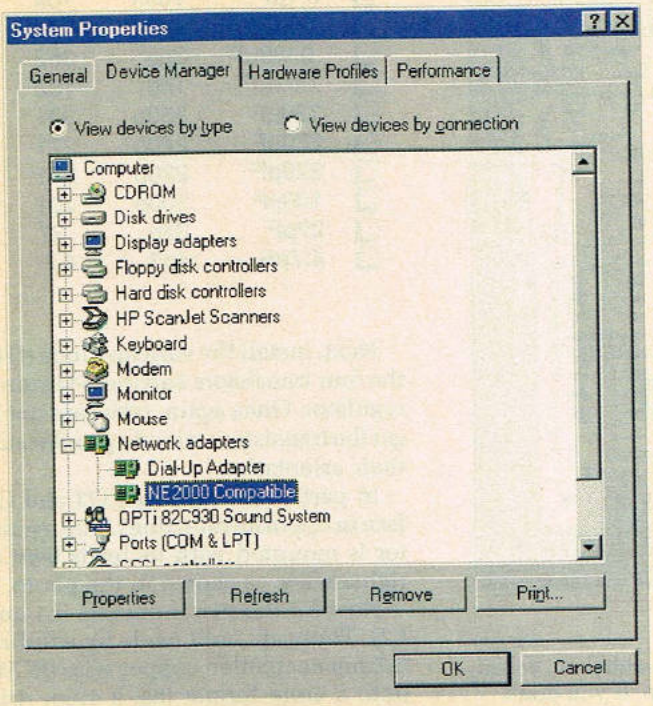


Fig.5: click on Start>Control Panel>System>Device Manager to bring up this window, showing which devices are installed and any problems (indicated by a yellow question mark).

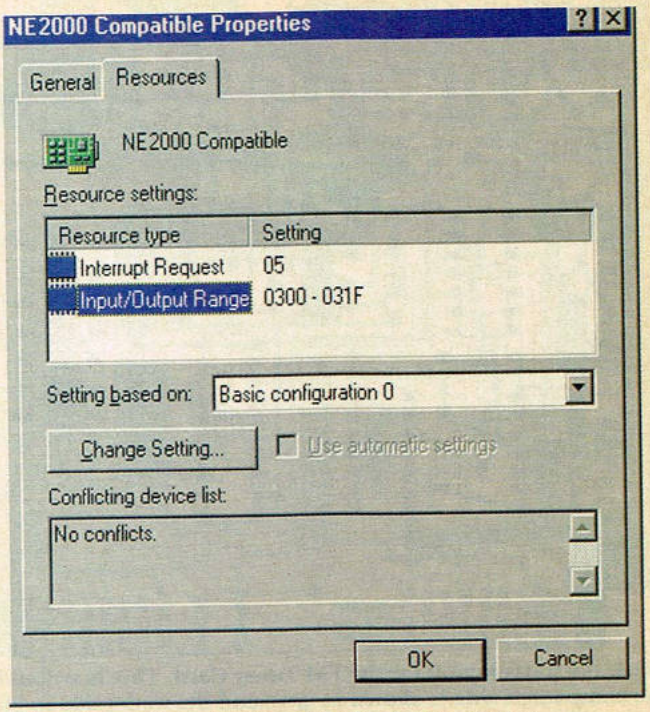


Fig.7: from Fig.5, double click the device you're interested in, then click the Resources tab and it will tell you which interrupt request (IRQ) and I/O range is being used by that device and, most importantly, if there are any device conflicts. In this case, we're in the clear.

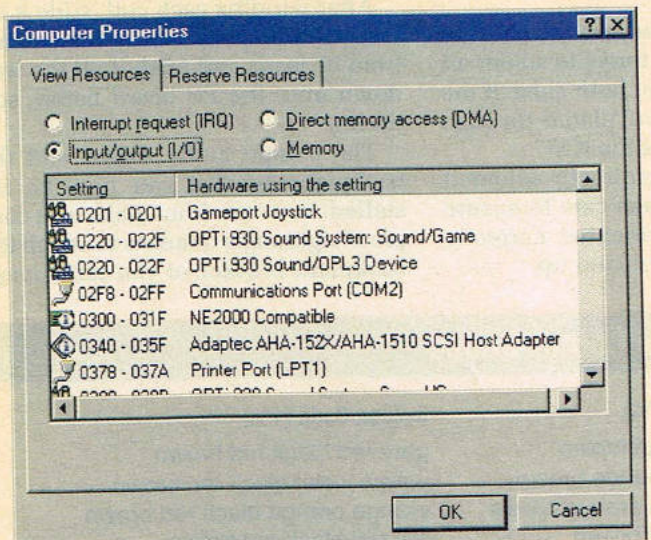


Fig.6: if you double-click the Computer icon in Fig.5 above, then select Input/output (I/O), you'll get a complete listing of all I/O addresses being used and the hardware that's using them. By selecting the other buttons at the top of the window, you can also find which IRQs are being used and by what, which memory the devices are using and also which devices are using direct memory access (DMA) channels. The Reserve Resources tab allows you to allocate resources for legacy cards if necessary (ie, non-PnP cards) to avoid conflicts.

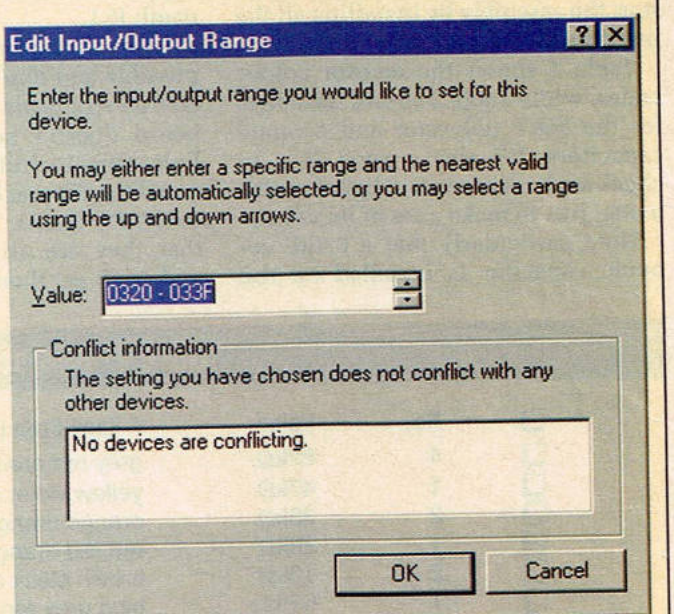

Edit Input/Output Range
Enter the input/output range you would like to set for this device.
You may either enter a specific range and the nearest valid range will be automatically selected, or you may select a range using the up and down arrows.
Value:
0320 - 033F
Conflict information
The setting you have chosen does not conflict with any other devices.
No devices are conflicting.
OK
Cancel

Fig.8: if necessary, you can manually change the resources allocated to existing cards – just select the setting you wish to change in Fig.7, then click the Change Setting button and enter in the new values . One bonus is that you get to see immediately if you have entered values which conflict with other devices. If so, change the values to something that doesn't cause problems!

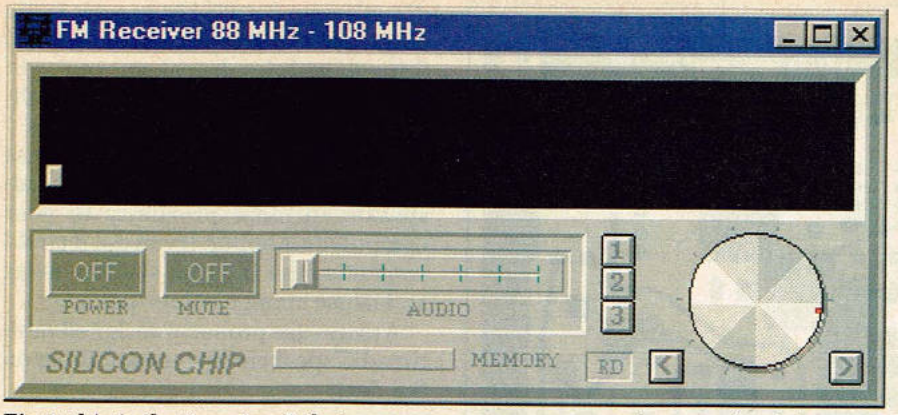


Fig.9: this is the "receiver" that pops up on your screen when you load the software. At this stage it is not turned on – clicking the "power" button will do that for you. The other controls are a slide volume control, three memory preset buttons, a "rotary" tuning knob and a pair of "click and hold" tuning buttons.

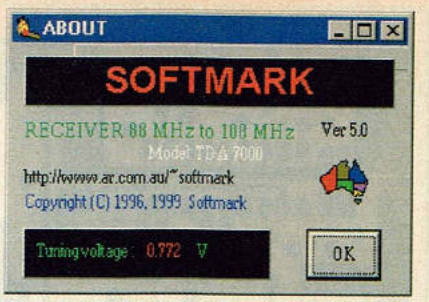


Fig.10: clicking on the little button at bottom left of the dial scale brings up this "about" box which, among other things, tells you the voltage being applied to the varicap diode to tune the station being listened to at that time.

a backplane bracket with integral attaching points from an old expansion card. A hole will have to be drilled in the bracket, to align with the audio output socket. Once all the parts have been fitted, you will notice that there are quite a few vacant holes.

If you don't have a plated-through board, what you have to do now is install "pin-throughs" at each of these hole locations. These can be made from tinned copper wire and are soldered to both sides of the PC board.

Now would also be a good time to check that all component leads are soldered to their pads on the top of the PC board. Don't neglect this step – one missed solder connection on the top of the board is enough to stop the circuit from working.

Strictly speaking, you only have to solder those pads on the top of the PC board that have tracks running to them. However, by soldering all the pads, you can be sure of not missing any.

Finally, connect an antenna by soldering a 750mm length of light-duty hook-up wire to the PC board. The antenna lead is then fed through the backplane connector via a small hole drilled adjacent to the antenna connection point.

Software

The software for this project can be downloaded from the SILICON CHIP website, www.siliconchip.com.au. The download is free and the file you want is called Pcfmtune.zip (it will be at or near the end of the downloadable software listing).

You'll find it by clicking the "Software Downloads" link on the home page. If you don't have Internet access, you can buy the software on two floppy disks from Silicon Chip Publications for $12, including postage).

Unzip the file after downloading, then install the software by running setup.exe. Assuming you're running Windows 95/98, this will install the files in a folder called 'vhf' and install the necessary entries in your Start menu.

Installing the card

You will need to set the I/O address of the card before installing it in the computer. In most cases, the default address of 300H should work just fine. This is set be installing the jumper across pins 2 & 3. If you strike problems, try the alternative 301H address setting (ie, jumper pins 1 & 2).

Neither of the available addresses should cause any conflicts with commercial expansion cards. If you do strike problems, you can check the resources that are being used via the System Properties utility in Windows 95/98.

To view these, double click the System icon in Control Panel, click the Device Manager tab and double-click on Computer at the top of the list of devices.

You can now check the I/O addresses that are in use by selecting the Input/Output (I/O) button – see Fig.6. If you do find a card that occupies the 300H/301H address space, try changing the resources assigned to that card.

To do this, double-click the device in the Device Manager list, click the Resources tab, click on the resource setting you wish to change (in this case, the Input/Output Range) and click the Change button – see Fig.7.

Note that if the card isn't a plug and play type, it will also often be necessary to change its configuration using the software setup disk that came with it. Having said all that, we don't expect too many problems with resource conflicts. In nearly all cases, is should simply be a matter of plugging it in.

By the way, don't forget to connect a loudspeaker. As mentioned at the start, the audio output from the PC FM tuner isn't directed through the sound card, so you can't rely on its loudspeakers.

If you have a spare pair of multimedia loudspeakers, try plugging them

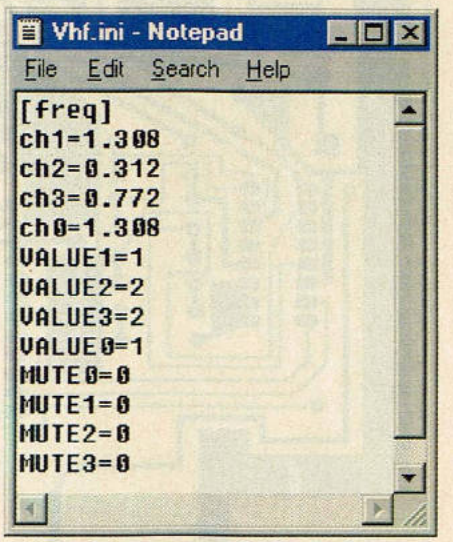
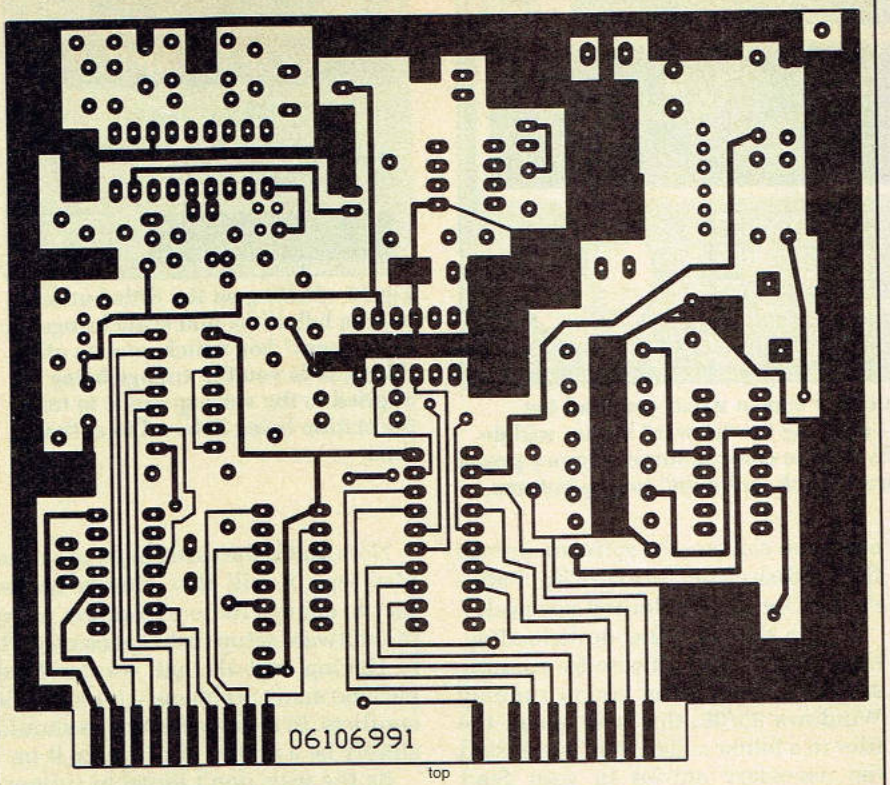


Fig.11: this screen grab shows the contents of the vhf.ini file which records the preset channels, their volumes and the mute status. If you *really* wanted to, you could alter the data using a text editor and the FM Receiver would respond next time it is turned on. But why bother when the software does it all for you anyway?



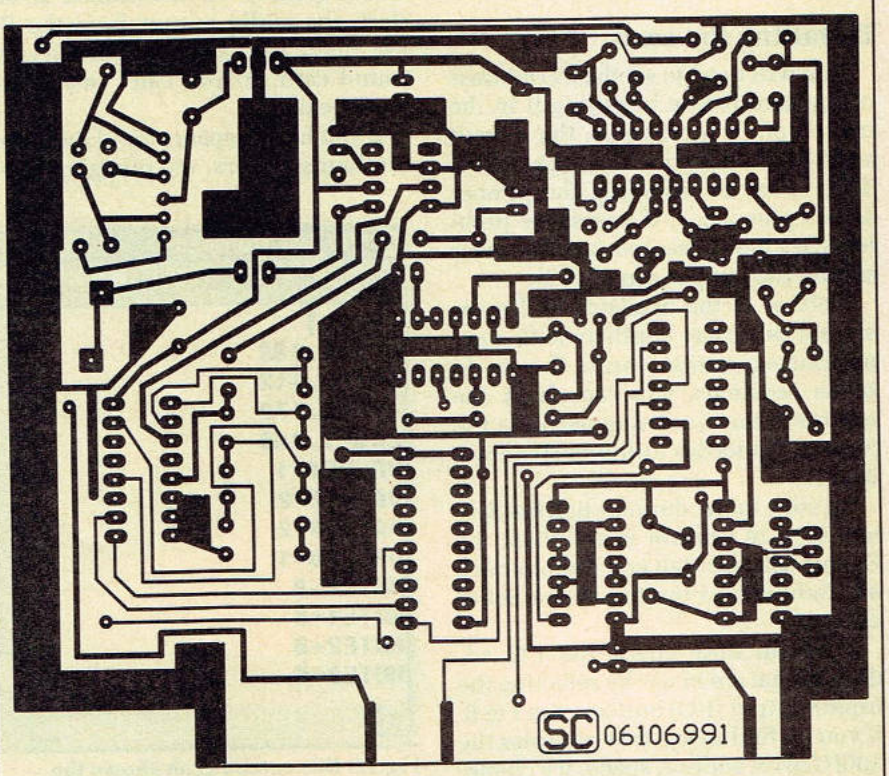


Fig.12: two patterns are required for this double-sided PC board. The pattern above is for the top (component) side while the pattern below is the 'normal' copper side. If etching your own board for this project, great care will need to be taken to ensure that the two patterns line up correctly on the blank board. The easiest way to do this is with some form of pin registration on the board and through the film patterns.

directly into the PC FM tuner's audio output socket. If you get sound (mono) through both loudspeakers, you're in business. If not, you will need a suitable mono-to-stereo adapter socket.

A word of warning here – do not use a conventional (unshielded) loudspeaker in close proximity to your computer's monitor. If you do, it could magnetise the internal shadow mask and cause strange colour patches.

Always use properly designed multimedia speakers if you want them on the desk.

Test & alignment

Now run the software (Start, Programs, FM Receiver, FM Receiver). The first thing you should see is the FM Receiver image on screen (see Fig.9) but you shouldn't hear anything yet, because you haven't turned the "receiver" on.

Move your mouse pointer to the "on" button and click it. The FM receiver "dial" now lights up and the power button illuminates green. Now you should hear some sound coming from your speaker(s). Clicking on the "mute" button should quieten interstation noise.

Click the mute back off and try tuning in some stations. If you're within about 20-30km of some reasonably strong FM stations, you should be able to pick them up.

Sweep through the entire frequency range and keep a record of the stations you hear and their locations on the 'dial'. You will need to know which stations are on which frequencies – in many cases, FM stations broadcast their frequency as part of their callsign or station promotions.

If the indicated station frequencies are higher than they should be, spread the turns on inductor L2 to decrease its inductance. Conversely, if the indicated frequencies are too low, push the turns closer together.

Basically, it's just a matter of adjusting L2 so that you can tune right across the FM broadcast band (from 88-108MHz) with the stations in the correct locations on the dial. Be sure to make only small adjustments to L2 at any one time before re-checking the frequency range.

Make sure too that the computer is switched off each time you remove and replace the tuner card, to avoid possible damage to this card or to the motherboard. **SC**

MAILBAG

Feedback on Command Control

I have just completed construction of the Command Control project for model railways that appeared in the January to June 1998 issues, together with the revised decoder design which appeared in March 1999.

The original decoder design that appeared in May 1998 has an error in Fig.9 on page 65. The 3.3kΩ resistor shown next to trimpot VR1 should actually be 100kΩ. If 3.3kΩ is used, the internal reference frequency for the servo controller is out of specification and it will not work correctly.

I agree with Cam Fletcher's comments in the March 1999 article about the difference between pulse width modulation (PWM) and linear control of DC motors. I tested each of the decoder designs in a LifeLike GP9 Phase III locomotive with a 5-pole skew-wound permanent magnet DC motor and a Hornby LNER Flying Scotsman loco with a Ringfield Type 5 large diameter permanent magnet DC motor.

The PWM decoder made the GP9 "growl" at low speed (almost like a real diesel electric!) and the Ringfield motor of the Flying Scotsman had low speed problems with PWM. The linear decoder was good with either style of motor and overcame the low speed problems with the Ringfield motor type.

The model railway layout and details of how I mounted the decoders can be seen at:
http://www.fam.aust.com/hmjgc/justin

J. Giles-Clark (via email)

Comment: we published errata about the decoder resistor value in the March 1999 issue and we have a further note on a possible tendency for a buffer malfunction in the Command Control Encoder, in the Notes & Errata for this issue on page 93.

Suggested improvement for RPM limiter

I found John Clarke's engine RPM limiter design in the April issue very timely and interesting and I'd like to share a couple of ideas that I hope will make it easier to set up and make it work better on older cars with conventional points-based Kettering ignition systems.

Mr Clarke pointed out that the limiter will produce quite rough engine operation on older cars with points when it cuts in, because its ignition blocking action will confuse its own engine speed sensing circuit by also interrupting the supply of engine timing pulses from the points.

One solution is to add a "sample and hold" circuit to hold the output voltage of the LM2917 speed sensing circuit constant for the duration of the ignition blocking pulse. Fortunately, this can be done by adding a small logic-level gate drive enhancement-mode MOSFET as an analog switch, a gate stopper resistor for stability, plus some protection diodes and a current limiting resistor. (Editor's note: circuit to be published next month).

Also, the suggested method of calibration and set-up is inconvenient and rather anti-social. I don't think driving a performance car up and down a (formerly) quiet suburban street in low gear with the engine roaring at maximum revs will be popular with the residents, and it might even attract some unwelcome attention from the boys in blue!

Because the LM2917 has very good linearity, the RPM limiter can be satisfactorily calibrated using a signal source at a single known frequency between 100Hz and 200Hz. Once the LM2917's output is set to a suitable voltage corresponding to the known frequency source's equivalent RPM, all the RPM threshold pots can be set with a DVM after calculating the appropriate multiple of the calibration setting voltage to correspond with the desired RPM values.

An accurate 100Hz source can be derived from the mains using a centre-tapped 12.6V transformer, two diodes and a resistor. This will provide simulated engine revs of 3000, 2000 & 1500 RPM for 4, 6 & 8-cylinder engines respectively.

By the way, I'm puzzled by the use of an 7805 regulator in the limiter when the LM2917 already has a built-in 8V active zener shunt regulator that appears to have sufficient current and voltage regulation capability to power all the low voltage circuitry. It might drop out of regulation when the starter motor is cranking or when idling with a flat/worn-out battery but that wouldn't matter. It seems to me that the 7805 could be replaced with a 470Ω resistor, with only one resistor value change required to keep the LM2917 input comparator threshold at 2.5V. Is this right, or have I missed something?

B. Hirshman,
West Pymble, NSW.

Comment: since the dynamic impedance of the LM2917's internal zener is fairly high, we have taken a conservative approach by including the 7805 regulator.

Tip on exploding Fets

I am writing in regard to the "Exploding Fets..." query in "Ask Silicon Chip", April 1999. I will admit that I am only guessing but one potential problem with the 40V/8A power supply (published in April & May 1998) relates to the method used to protect Q1 and Q2 from voltage spikes at the drains of these transistors. That method relies on zener diodes ZD1 and ZD2 conducting when the breakdown voltages of these diodes are exceeded, as in the case of a switching spike. In such an event, zener diode ZD1 or ZD2 conducts, turning on Q1 or Q2. In theory, this shunts excess spike energy to earth before it has a chance to do any damage.

This assumes that Q1 or Q2 will react instantly. However, real-life transistors have a finite response time. Therefore, if the spike energy at the drain is high enough and the rise-time sufficiently short, and if the response time of Q1 or Q2 is too slow, then it may be possible that the peak gate voltage due to the spike will be high enough to cause a breakdown in the gate-source oxide layer of the Mosfet.

To prove the point, measure the resistance between gate and source of the Mosfet. If it is measurable, then excessive gate-source voltage is a probable cause. The spike energy will

continued on page 88

SERVICEMAN'S LOG

It took longer but it cost less

Security systems aren't my normal run-of-the-mill fare and one that I recently encountered caused a few hassles. My other big hassle this month concerned a manual with a wiring error. And from New Zealand I have a story about an 11kV power line which tangled with the 230V supply.

My first story this month is about time-lapse video recorder security systems. Rather than scan continuously at the usual 25 frames per second, they take a single picture every few seconds.

These expensive high-technology systems are fast becoming superseded. They are being replaced by lower cost PIR (passive infrared detectors) and add-on security kits for ordinary video recorders, which are activated only when movement is detected.

Most older time-lapse systems cost around $2000 and are designed to run continuously, recording up to 720 hours on one tape. Obviously, they require regular maintenance and most are supplied with clocks to remind busy security control rooms that it is time for a service every 1000 hours. Nevertheless, they inevitably don't bother with this until something actually fails.

An urgent job

So it happened recently that a local security company brought in a Sanyo TLS-1000P recorder, complaining that it wouldn't play and that it chewed tapes. The security officer who dropped it in said that the job was urgent but the manager of the company wanted a quote first. "Well, it's either urgent or you want a quote; which is it?", I replied. He called the manager, a man named Bob, on his mobile phone.

"Look", Bob said, "the machine is about 10 years old" (he was right about that). "Is it worth fixing and if so, how much?"

He told me that he really didn't want to go to the expense of replacing it and in the end we agreed to go ahead with the repair, up to a limit of $300.

Because the job was urgent, I attacked it straight away. First, I noticed that the hour meter on the front panel was showing 10,000 hours or full scale deflection. This timer uses a mercury column inside a 3AG fuse which is permanently connected to the switched 12V rail.

I have absolutely no idea how it works or how to reset it; perhaps it has to be plugged in upside down? What I do know is that it isn't available as a spare part any more.

Anyway, after all this time, it was due for a major service in anyone's language.

The second thing I noticed was that it didn't want to accept tapes. I removed the covers and saw the major problem immediately – the capstan motor belt to the reel idler had broken and all the other belts looked in a sorry state.

A new belt kit was fitted and this time the tape went in straight away and all the main functions appeared to work OK. However, when I tried to eject the tape, it didn't want to.

Each time the recorder is switched off at the power point and switched back on, the letter "P" appears to indicate a power failure. The recorder then has to be reset. When I did this, the tape ejected properly. I then tested it a number of times and it worked faultlessly.

Having solved the main problem, I cleaned the rest of the machine and checked all the items listed in the maintenance table. I replaced a few suspect or worn parts but despite its high usage, it really wasn't in bad nick.

Noisy mode select switch

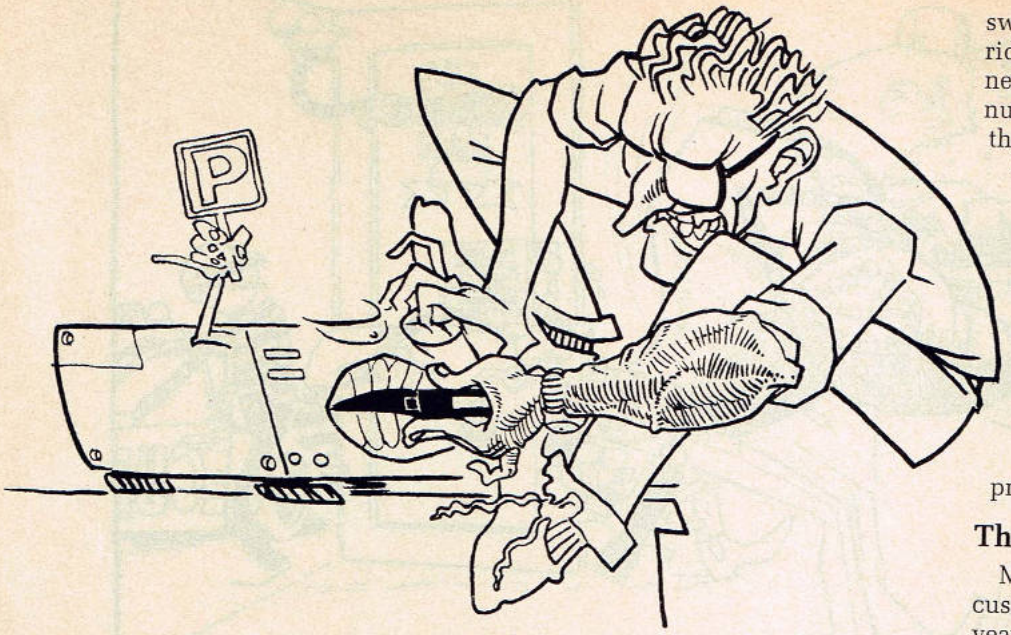
When I had finished, I put the tape in again to test it and once again the set seemed unsure as to whether to accept it or not. I felt sure this was due to a noisy mode select switch and gave it a good squirt of switch lubricant. After that, it worked like a Swiss watch.

The switch obviously had to be replaced and so I ordered a new one from Sanyo, only to be told that it was no longer available – after all, the set was manufactured in 1989! As the mechanism is similar to the VHR3500 and VHR3700 VCRs, I wondered whether the part number had changed but a quick check soon showed it hadn't. Fortunately, I decided to look through my local parts supplier's catalog and noticed from the pictures that he had genuine new ones in stock and so I ordered one.

It arrived the next day, just as the old one was playing up again. Anyway, I managed to get a tape in so that I could align the switch to its notch position. I then turned the machine

Sets Covered This Month

- Sanyo TLS-1000P time-lapse video recorder
- Sharp V1 Stereo A-V System
- Sanyo Model C14ZA25 colour TV set



WHEN I TRIED TO EJECT THE TAPE, IT DIDN'T WANT TO

off before unscrewing and unsoldering the switch terminals from the PC board. The new one was just as easy to fit and no further adjustment was necessary.

Unfortunately, when I finally reapplied power, it still wouldn't eject. I checked all the other functions which were fine but, in the eject mode, the loading motor turned until the front (or "flont", as the manual spells it) loading gear engaged with the capstan motor. And that's as far as it got – the motor wouldn't turn at all.

It was then I noticed that the surface-mounted fish-oil capacitors on the stator board were leaking. Aha! These looked like likely suspects. After cleaning up the corrosion, the only problem was replacing them with small enough substitutes. However, after all that effort, when I was sure I was home and hosed, I was shocked to find that it still wouldn't eject.

Time for thinking

The moment I was dreading had arrived – I was actually going to have to get technical. I had already established that the capstan motor really was OK, as it worked in all functions except eject – it just wasn't being switched on.

It wasn't easy to work out which wires were responsible for switching on the capstan motor from the servo and syscon circuits so I decided to start with the mode select switch which determines, via the loading motor, the control of all the various functions.

I established that the eject and cassette-in modes occurred when the switch was in the "d" position, when the truth table gave a zero for the Data 1 and 2 buslines and a 1 for Data 0. The switch was actually built with four connectors which were, from left to right: common, Data 2, Data 0 and Data 1. As a result, I expected to see 5V on the third switch terminal (or leg) only.

However, this wasn't the case. Instead, legs 1, 2, and 4 were all high and leg 3 low – a mirror image! At first, I put this down to the switch not quite being in alignment so I checked it again – it was perfect.

I then confirmed that all the other functions in the truth table were correct. I checked the DC resistance but all I could come up with was that there was something wrong with the "d" position, especially when compared with the original switch. Eventually, I came to the conclusion that the new switch was faulty and so I refitted the original while I ordered another. And after all that messing about, the original now worked perfectly.

Now I must emphasise that the two switches looked identical, because the riddle was solved when I reordered a new switch and had to check the part number from the catalog. It was while the catalog was opened that I noticed a switch that looked exactly the same on the adjacent page but with an entirely different part number. It was this new switch that finally put the problem to bed.

Bob wasn't too happy with how long all this had taken but calmed down when he found out that the bill was a good deal less than he had been prepared to pay.

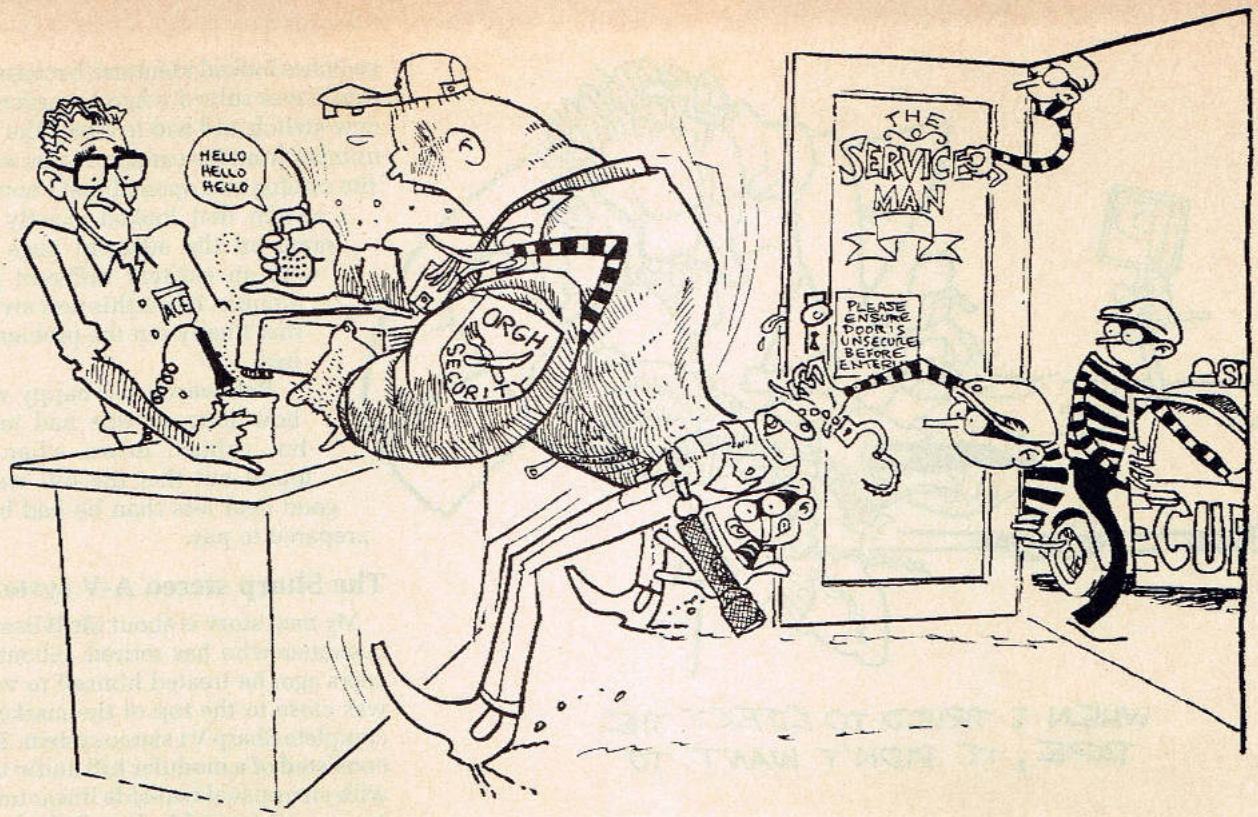
The Sharp stereo A-V system

My next story is about Mr Wilson, a customer who has retired. About 10 years ago, he treated himself to what was close to the top of the market; a complete Sharp V1 stereo system. This consisted of a modular hifi audio unit with an unusual two-side linear tracking record turntable (yes, it had two pickup arms) and a remote control system – all heavy stuff in the late 1980s. Matching this, and connected to it, was a 63cm stereo monitor-style TV set and a hifi video recorder, the whole lot mounted in a custom-made shelving system.

The thing that really dates it all now is the colour which was silver. Nowadays you can have any colour you want, as long as it is charcoal grey or black.

Not long after Mr Wilson acquired the pride of his life, it was damaged by lightning. Although everything else was fixed, the VCR was deemed to be a write-off and so his insurance company gave him the go-ahead to get a new one. Naturally, he chose another Sharp, this time a VC-6F3X. Unfortunately, this model was in black and no longer matched the rest of his system but he appreciated the additional features it offered compared to the VC-5F3X that had been destroyed.

Recently, he brought it in for a service as it was chewing tape and needed new belts and an idler. All this was straightforward and everything was going to plan until I decided to blow out the accumulated dust with an air compressor. This required only a gentle wave of the air-gun all over to bring it back to a clean state. This done, I confidently boxed it all up and put it aside for soak testing before



THE SECURITY OFFICER WHO DROPPED IT IN SAID IT WAS URGENT...

completing the paperwork.

Imagine my horror when I switched it on and found that I had lost all the sound in both the play and EE modes and that the LED meter display was no longer functioning. Trying not to panic, I opened it again and checked all the plugs and sockets to see if I had accidentally pulled any out. But no, and there was absolutely no sound coming out, not even from the AV output or the headphone socket. The only clue that anything at all was happening in the audio chain was that the stereo LED indicator still came on for each channel.

The picture itself was great. This all indicated that the audio signal must be reaching the stereo decoder, so I decided to start investigating PWB-1, which was the top board and is easy to access. Using my amplifier probe, I was able to trace the audio signal all the way up to the Input Tuner/Line analog switch (IC6101). This device is a TC4066 which is sometimes unreliable but fortunately easy to obtain.

The sound went all the way to pins 4 and 8 but no further. Similarly, sound injected into the AV input reached pins 1 and 11, so with a small flat bladed screwdriver I shorted pins 1 & 2, pins 3 & 4, pins 10 & 11 and pins 8 & 9 in turn but there was still no sound. I was about to replace the IC itself when I decided that it wouldn't hurt to be a bit more technical and check a few voltages.

First, I checked the switching signals on pins 5 & 6 and pins 12 & 13 with a voltmeter to find nothing there. I then checked the +12V supply (Vcc) on pin 14 but this was absent also.

At last I was onto something. All I had to do now was trace this 12V rail to its source and find out why it had disappeared. Of course, I was still expecting something like a loose plug or a switch parked in the wrong position.

The 12V rail comes in on plug 1M2 which comes from BA11. As there is a large wiring harness, where was BA11 situated? Simple, look at the wiring diagram and sure enough it is shown coming from PWB-B, the audio board.

But, in reality, it doesn't. It took nearly half an hour to discover that this is an error in the schematic diagram. Instead, the 12V rail actually comes from PWB-F, which is in a completely different location underneath board PWB-1 instead of a wired audio module on top of PWB-A (the manual is not very forthcoming with information about each board's location).

Anyway, back to PWB-F. The 12V source was Q6311, which was part of a switchable regulator circuit whose source was AT17V from BD-1, which was connected to plug AS1 on main board PWB-A.

Did I mention that access to this board wasn't easy? Well, it wasn't – I had already visited it once in the mistaken belief I was going to PWB-B and had only just put it all back when out it had to come again.

The circuit for PWB-A is drawn out over two full A3 pages, so it took a little while to work out that the 17V rail comes in on AF7 from the power supply PD-1. This time I had the 17V so there was a break between the two plugs.

Using a voltmeter, I found that the 17V disappeared about 25mm from AF7 and never reached AC1, AW1 and AS1. In fact, it looked as though a link was open circuit. Unfortunately, the link could not be seen from the component side as the plastic cabinet protruded over this area – not to mention the wiring harness to six plugs in the vicinity.

And so I was forced to remove the

main board PWB-A. This is a major undertaking involving screws, clips, wires and an awful lot of swearing. Eventually, I had the assembly and its three daughter boards and tuner out on the bench. A quick inspection of the area involving the link (357) soon cleared up the mystery.

There was a spot about 25mm in diameter of severe green, black and white staining, where corrosion had taken place from an unidentified toxic liquid. After cleaning off the debris with every solvent known to man, I could see that the link had in fact disappeared completely, leaving tiny fragments in the pigtail holes to the PC board. After replacing the link and cursing some more while I got it back together again, I found (to my relief) that everything now worked properly.

But how did all this happen? How did a small amount of liquid get into this location without touching anything else, especially as the lid and two other boards overhang this area. Well, I can only surmise that it dripped down the side of the plastic casing, even though there were no other marks. It guess that it could have been water from a pot plant and but why did it only decide to fail when I used the air-gun?

I can only put it down to Murphy's law and move on. The really tricky part was explaining all this to Mr Wilson.

Kiwi power

And now for a change, here is a contribution from a fellow serviceman – S. W. in Hamilton, New Zealand. I well remember reporting a similar catastrophe that occurred here some years ago, on the NSW South Coast . Anyway, here's S. W.'s story.

I was awoken early one morning by a loud bang. Being of the cautious nature where loud bangs are concerned, I made an attempt to determine the source. It was a wild, stormy night, so the first thing that came to mind was the power. Everything in the house was functioning OK and I checked the meter and distribution boards. Everything appeared to be in order, so I went back to bed.

Later that day, I had a run of dead appliances in for repair. It turned out that a tree had fallen on the 11kV lines that feed our area and brought them down on the 230V lines underneath, sending 11kV through everyone's houses and businesses. It was all very messy but I got off scot free – technician's luck, I guess!

FRUSH MULK
CUT DOOR
A TREE HAD FALLEN, SENDING 11kV THROUGH EVERYONE'S HOUSES AND BUSINESSES. IT WAS ALL VERY MESSY, BUT I GOT OFF SCOT FREE...

Most of the appliances were TV sets, followed by microwave ovens, surge protection devices of the plug-in variety, and stereo systems. In the majority of TV sets, the mains fuse had exploded into a molten mess and the current limiting resistor (usually 5W or 7W wirewound) in the power supply had simply gone open circuit.

This is interesting, given that these components are on the other (appliance) side of the mains switch and that these sets were not turned on at the time. In every case, the high voltage had jumped the switch contacts and into the circuit. Several sets also lost chopper transistors and bridge rectifiers or sets of diodes on the input side of the power supply.

Some TV sets and almost every microwave oven had varistors fitted on the mains input filter boards. These had all suffered and bits of the varistors were found scattered in all directions.

One of the TV sets was a National, which was imported from overseas and had an auto-adjusting supply (110V-230V). It must have had a hernia when it saw 11kV and it took out the current limiting resistor, four diodes and a Triac.

The surge protectors were deemed write-offs; it was cheaper to buy new ones than to repair the dead ones. The microwave ovens suffered varying degrees of damage. In addition to the faults listed above, several ovens had the primary winding on the low voltage transformer destroyed.

The stereo systems had tracks blown off the PCBs and some lost varistors as well. It is interesting to see that more and more equipment is now being fitted with varistors as a form of spike suppression.

The damage to equipment was fairly limited in this instance, due to the surge being spread over a wide area. I have seen the results of a similar situation involving just one rural road where the same thing happened and suffice it to say, there was nothing left of the gear. It had just vaporised.

The real damage was caused by the meter boxes being blown off the outside walls of the houses and landing some 5-6 metres away. Inside the houses, distribution boards caught fire and set the interior alight.

Red herring

But back to the present and an encounter which I've called "The Red Herring". Later that week, a Sanyo 34cm model C14ZA25 came in. The owner said that it had stopped working the night of the storm and he'd taken it to another serviceman to have it looked at. When he'd gone to pick it up he was told that the price was in the region of $120. He wasn't prepared to pay that much and the serviceman concerned "took the parts out that he'd replaced" and gave the set back to the customer.

I agreed to take the job on the theory that the removed parts would be easy to identify and it would cut down the amount of work I had to do.

The following day, I opened it up and inspected the underside of the PC board. R502, a 3.9Ω 6W resistor in the power supply, had been taken out and the solder around a blank area marked as transformer T581 had also been disturbed. But there was no actual transformer on the board.

A check of the rest of the board showed that no other parts had been replaced. At that stage, I remembered the price that he'd been quoted and came to the conclusion that the transformer must have made up the bulk of the cost. I rang the local Sanyo parts supplier to check the cost of a replacement transformer, only to be told that he could find no reference to T581 in that particular set.

I went back to the service manual and opened it to the inside cover which shows the basic set layout (not the circuit). And right there in the power supply section was T581. It is shown as a small step-down transformer, used to supply the low voltage parts of the circuitry when the set is in the stand-by mode.

It seemed logical that it could have failed, as it would be connected directly across the mains input to the set. The front cover of the manual specifically says "New Zealand" in brackets under the model number so I knew I wasn't looking at a universal manual or a copy of a manual for a different market.

I was still not satisfied and called Sanyo's head office only to be told that they, too, could find no reference to a T581.

"But it's shown in the manual", I said.

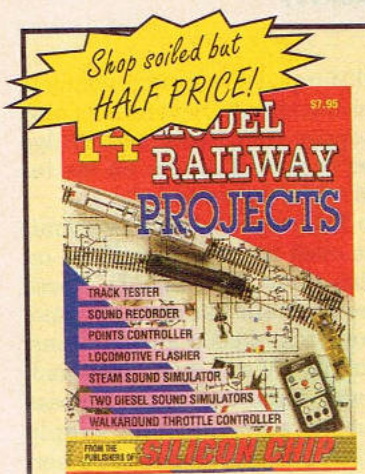
"Hmmm, so it is", came the reply.

I went back to the manual and took a look at the circuit diagram proper. And surprise, surprise – there was no sight of T581. Now I was really confused. It appeared as if it had been replaced, it was in the layout but not in the circuit diagram, and no one could reference it.

I put the set to one side while I worked on other jobs and when I came back to it, decided to have another look at the PC board. On closer inspection, I soon discovered that the tracks that led from what would be the secondary side of the transformer weren't actually connected to anything! It was definitely a furphy! I replaced the 3.9Ω resistor and the set sprang to life.

In hindsight, the solder on the holes marked for T581 might have been disturbed purposely to throw the next poor bloke who looked at the set right off the trail. It certainly worked!

In the end, the only part that had to be replaced was a 75 cent resistor. The customer was more than happy with the bill and I am a bit more wary of service manuals and red herrings! **SC**



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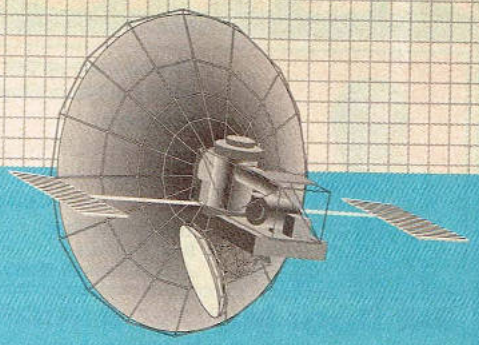


Compiled by GARRY CRATT*

Asiasat 3 shuffle

After a successful launch in March, and in-orbit testing during April (at 98.2°E), Asiasat 3 is expected to have commenced operations at 105.5°E by this month. Asiasat 1 will be relocated to 122°E. To make room for this, Asiasat G (carrying NTV Russian commercial programming) was suddenly switched off on April 28 without warning.

NTV programming recommenced on Gorizont 30, located at 130°E on April 29.

Panamsat 2 (169°E)

NHK is scheduled to leave this satellite early this month. BBC has returned to the California Bouquet (SR 30800, FEC 3/4, 3901MHz, horizontal polarity). The service is still running on 3743MHz vertical polarity SR 21800, FEC 3/4. Exactly why this parallel operation exists is unknown.

Religious broadcaster EWTN moved to Pas-8 transponder 11 C, SR 27690, FEC 7/8. CNN International will also leave this satellite by June 1.

CMT have advised that they will encrypt their signal in the second half of this year. The signal has been free-to-air for several years. The subscription service will be available to private users for a modest fee, although exact details are not yet known.

An interesting side note: when using a small aperture dish such as 1.8m to view Pas-2, the analog signal at 3860MHz is clearly visible on Pas-8. As dish size is increased, this effect is less noticeable as the beam width decreases.

Some multi-service commercial sites will find services previously available on Pas-2 now spread across both Pas-2 and Pas-8. Panamsat is using a multi-beam feedhorn on existing receive dishes to allow simultaneous reception from both satellites.

Panamsat 8 (166°E)

An intermittent analog test signal has been running on this satellite since mid January on 3860MHz, horizontal polarity. Japanese broadcaster NHK commenced their digital service on February 16th. Results indicate that no change will be necessary in dish size for NHK viewers.

CNN International will also permanently move from Pas-2, tentatively scheduled for this month. The multi-channel service commenced Pas-8 parallel operations in digital format during May on 3780MHz, horizontal polarity, SR 24999, FEC 3/4, in non-conditional access PowerVu format at that time.

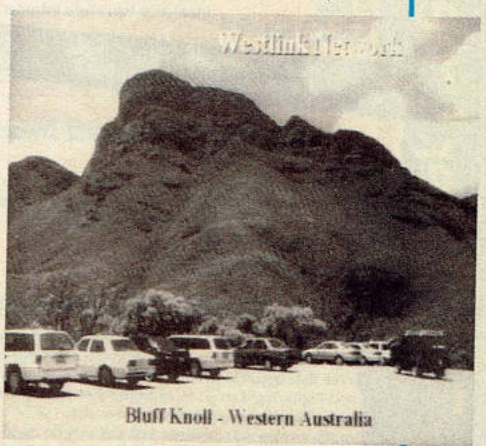
Feb 1 saw a new digital bouquet appear on 3940MHz, horizontal polarity, SR 27690, FEC 7/8. Loaded headers indicate TNT/Cartoon as services that will transfer from Pas-2. TNT is due to cease operations on Pas-2 by June 1.

Palapa C2 (113°E)

TV Indosair has ceased analog transmissions and changed frequency for their new digital service. Parameters are: 4073MHz, vertical polarisation, SR 6500, FEC 3/4. This is an Indonesian beam, probably only covering the very northern edge of Australia. We have been unable to receive the signal in Sydney using our 4.5m dish. MCM has also left this satellite.

Taiwan C Net continues to operate their 21-channel NTSC bouquet on 3763MHz, horizontal, SR 21093, FEC 5/6 now using conditional access. Services still load on most digital receivers, but the video is blanked, hence only audio channels are available.

Optus B3 (156°E)



Bluff Knoll - Western Australia

The Aurora platform is now operational on this satellite, carrying ABC, SBS, 7 Central, Imparja, Horizon, Westlink, Prime and many other services. Frequencies are 12407MHz, SR 30000, FEC 2/3; 12532MHz SR 3000, FEC 2/3; 12595MHz, SR 30000 FEC 3/4; 12720MHz, SR 3000, FEC 3/4. All transponders are vertically polarised.

Anteve has commenced digital operations on 4193MHz, vertical polarisation, SR 6508, FEC 3/4. A 3.7m dish is required to receive this signal along the east coast of Australia.

Intelsat 701 (180°E)

European broadcaster Fashion TV has replaced Saudi TV channel 1 and MCM Asia has replaced Abu Dhabi TV. Both services are on 4095MHz, LHCP, SR 27500, FEC 3/4. **SC**

*Garry Cratt is Managing Director of AvComm Pty Ltd, suppliers of satellite TV reception systems. Phone (02) 9949 7417. http://www.avcomm.com.au

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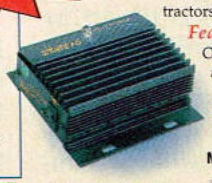

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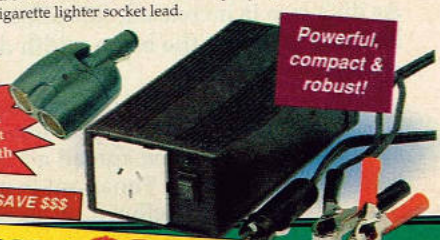

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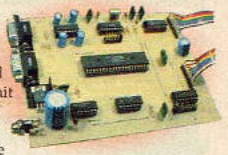

(See EA July '91)

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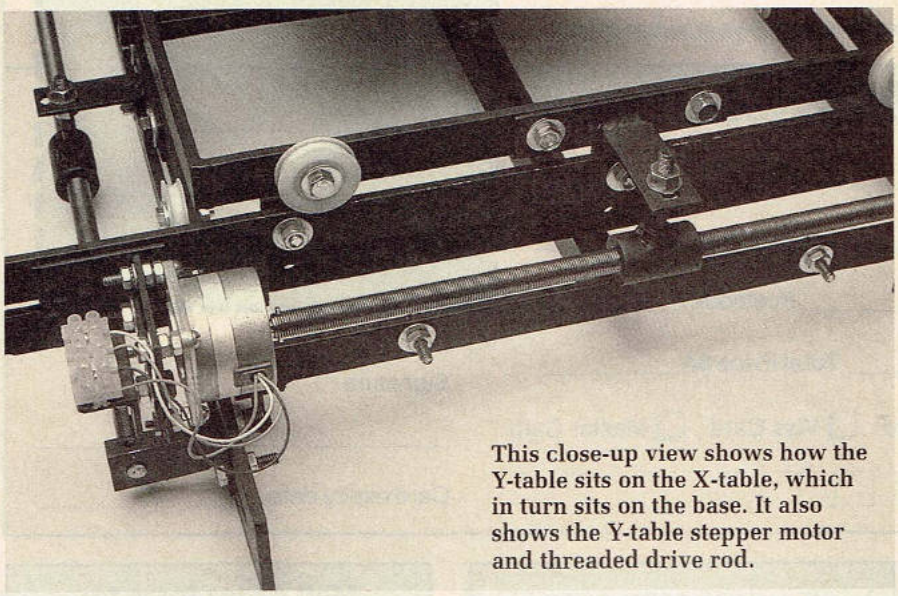
X-Y TABLE WITH STEPPER MOTOR CONTROL

Part.2: Building The X-Y Table

Last month, we introduced the hardware and software for this XY table with stepper motor control. This month, we cover the construction of the XY table using flat steel sections, threaded rods, the stepper motors and various pulleys.

The X-Y table was fabricated from various thicknesses of black steel plate and bar. If you plan to build one we assume you have some experience in cutting, drilling and welding this type of material. Alternatively, you may already have some equipment to which you can fit the motors and driveshafts.

We have used 1/4" Whitworth bolts wherever a bolt is called for unless a different type is specified and when we say to drill a hole, it means a 1/4" hole. Whitworth bolts are the only ones readily available from most hardware stores even though Australia is nominally a metric country.



This close-up view shows how the Y-table sits on the X-table, which in turn sits on the base. It also shows the Y-table stepper motor and threaded drive rod.

Base construction

Fig.6 shows the details of the base. Cut two pieces of 25 x 6mm bar 450mm long and mark the centre-line. This centre-line must be extremely accurate as the final result, in terms of smoothness of movement and reproducibility of results, will depend on it.

Centre-punch points at the middle (225mm) and 190mm either side of centre and then drill the holes (1/4").

Cut two pieces of 25 x 6mm bar 390mm long. Draw centre-lines on these two bars and drill holes 110mm from each end.

The corner pieces are made by cutting four pieces 25 x 25 x 6mm then drilling and tapping each at the centre to take a 1/4" Whitworth bolt.

Set up and weld square the four drilled bars, making sure that the corresponding drilled bars are opposite each other, as shown in Fig.6. It is essential that the three-hole bars are parallel to each other. Now weld in the corner pieces. Each one of the these is fitted with a 2" x 1/4" bolt to

Mechanical Design & Construction by Ken Ferguson
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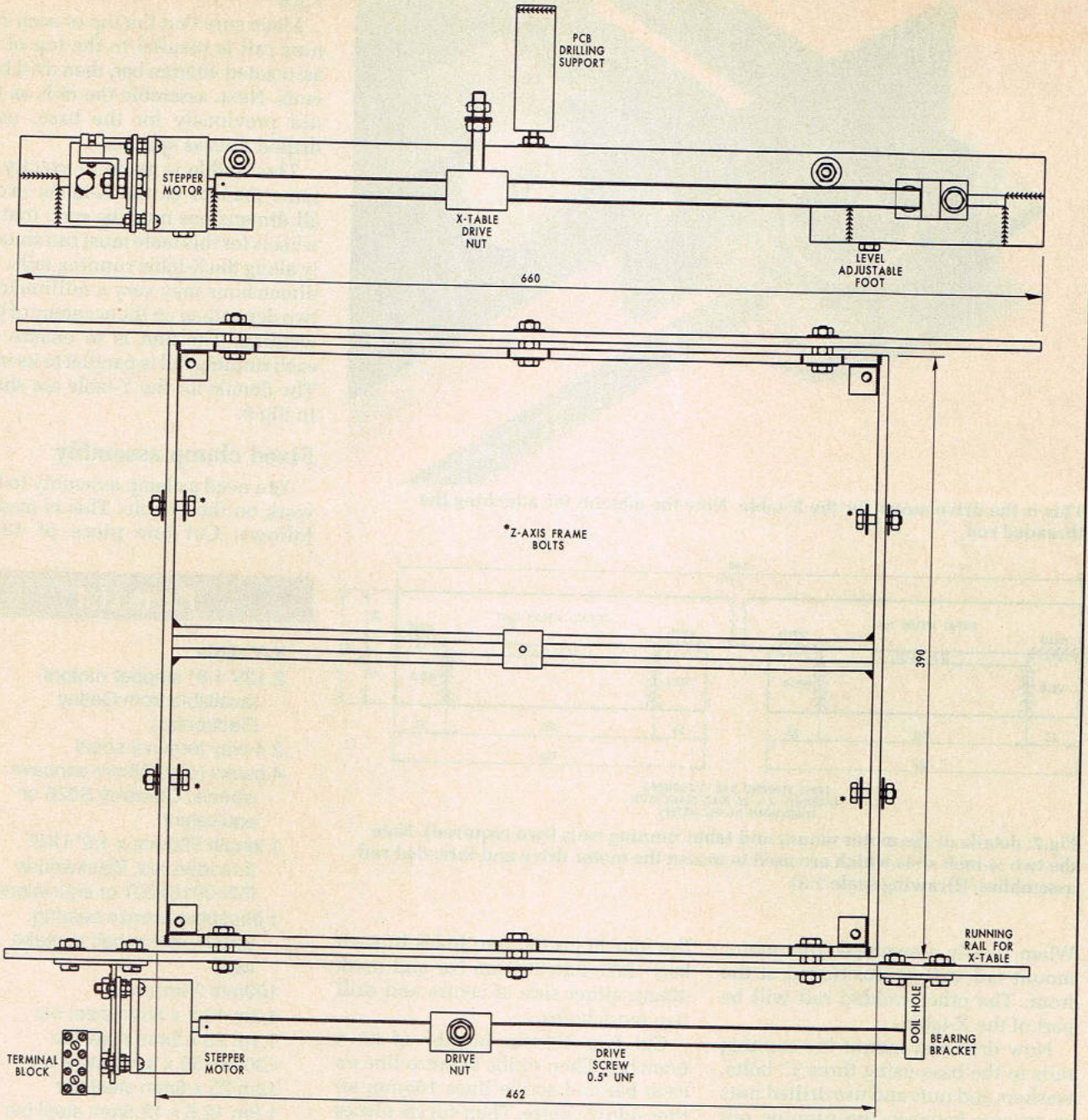


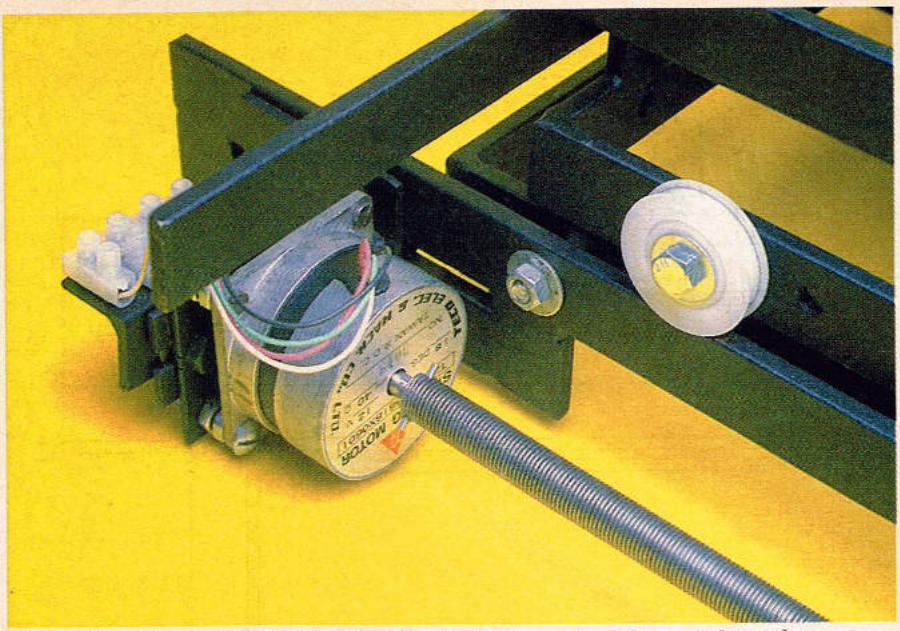
Fig.6: this diagram shows the construction details for the base. It carries the drive motor assembly plus two running rails for the X-table. Note that the diagram is drawn at a scale of 1:4.

provide a level-adjustable foot and each has a lock nut, as shown in the end elevation of Fig.6.

Next to be made are the drilling support bars. Measure the internal distance between the two 2-hole bars (around 450mm depending on how you welded the base) and cut two pieces of 25 x 6mm flat bar to this length. Weld them each side of centre, spaced 6.35mm clearance (use 1/4" bar + washer). These mount the drill support which will be detailed in a future issue.

Table running rails

Cut four pieces of 25 x 6mm bar 660mm long. Next cut four pieces of 25 x 6mm bar 100mm long and eight pieces of 25 x 6mm bar 31mm long. Weld these pieces onto two of the 660mm bars at both ends, as shown in Fig.7 and ensure that the slot formed is 1/4" clearance. One of these welded rails becomes the motor mount and table running rail on the base, as shown towards the bottom of Fig.6.



This is the drive motor for the X-table. Note the method for attaching the threaded rod.

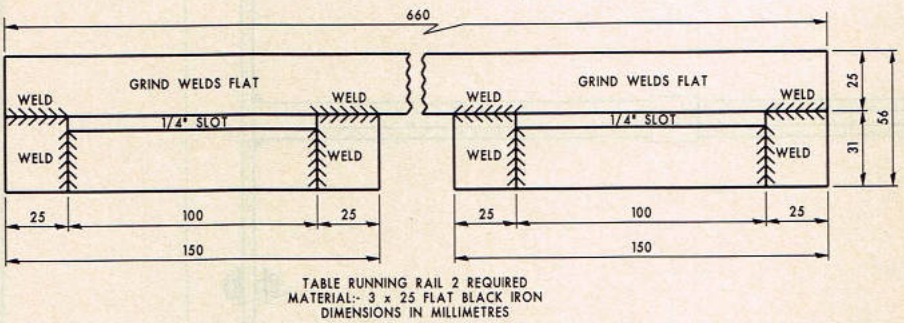


Fig.7: details of the motor mount and table running rails (two required). Note the two ¼-inch slots which are used to mount the motor drive and threaded rod assemblies. (Drawing scale 1:3).

When finally assembled, this motor mount rail will be positioned at the front. The other welded rail will be part of the X-table.

Now drill and mount the running rails to the base using three 1" bolts, washers and nuts and use drilled nuts as spacers between the running rail and the base. The welded running rail goes towards the bottom of Fig.6, as already noted, and the unwelded rail goes towards the top.

X-table construction

The X-table sits on the base rails while the Y-table sits on the X-table rails. The main details of the X-table are shown in Fig.8.

Cut two lengths of 25 x 6mm bar each 395mm long. Scribe a centre-line on each and centre-punch the middle of each bar. Mark points 142mm either side of centre and drill the four holes (ie, two holes in each bar). Take one 395mm bar and mark 40mm either side of centre and drill two more holes.

Cut two 403mm lengths of 25 x 6mm bar. Then scribe a centre-line on each bar and scribe lines 165mm either side of centre. Then cut six pieces of 25 x 6mm bar 30mm long.

Mark the centre-lines on each and drill a hole 15mm from one end. Weld three of these on the top edge of each 403mm bar, centred on the scribe marks. Now weld these two 403mm bars to the 395mm bars, as shown in Fig.8.

Take the remaining two 660mm running rails, draw a centre-line on each, punch the centres and drill the holes. Bolt the motor mount rail to the centre mounting bracket of the righthand 403mm bar and bolt the other 660mm rail to the centre mounting bracket of the lefthand 403mm bar, as shown in Fig.8.

Make sure that the top of each running rail is parallel to the top of the associated 403mm bar, then drill both ends. Next, assemble the rails as you did previously for the base, using drilled nuts as spacers.

The Y-table is made in exactly the same manner as the X-table, except all dimensions must be such that the wheels for this table must run smoothly along the X-table running rails. The dimensions may vary a millimetre or two depending on the accuracy of your welding. The aim is to ensure that each running rail is parallel to its mate. The details for the Y-table are shown in Fig.9.

Fixed clamp assembly

You need a clamp assembly to hold work on the Y-table. This is made as follows. Cut one piece of 12.5 x

Parts List

X-Y table

2 12V 1.8° stepper motors, (available from Oatley Electronics)
2 4-way terminal strips
4 packs (of 2) 38mm concave wheels, Cowdroy S926 or equivalent
1 length 900mm x 1/2" UNF threaded rod, Blackwoods P/N 00184201 or equivalent
1 phosphor bronze bearing BFB11 (cut in half to make two)
100mm 25mm rod
1.3m 12.5 x 3mm steel bar
1.1m 25 x 3mm steel bar
130mm 50 x 3mm steel bar
12m 25 x 6mm steel bar
1.8m 12.5 x 12.5mm steel bar
2 2½" x 1/4" Whitworth bolts
4 2" x 1/4" Whitworth bolts
6 1½" x 1/4" Whitworth bolts
40 1" x 1/4" Whitworth
52 1/4" Whitworth nuts
80 1/4" Whitworth flat washer
2 2" x 5/16" UNF bolts
2 1/4" Whitworth thumbscrew bolts
8 1/4" Whitworth wing nuts
2 springs to fit over 1/4" Whitworth bolts
8 bolts, nuts and washers to suit stepper motors

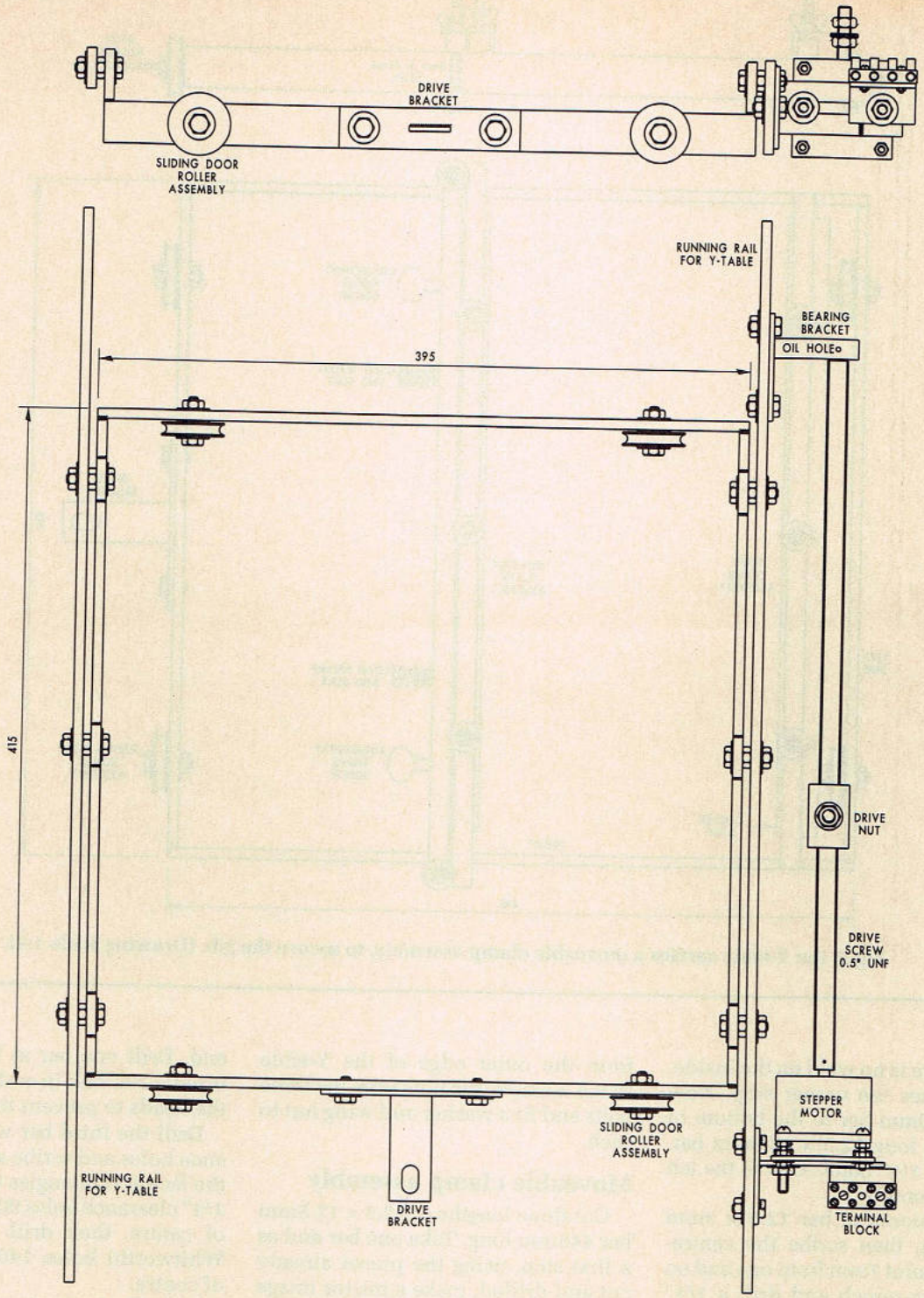


Fig.8: this diagram shows the main details of the X-table. It sits on the base and carries the two running rails for the Y-table, plus the Y-table drive motor assembly. (Drawing scale 1:4).

12.5mm bar approximately 415mm long (enough to reach the outside edges of the Y-table frame). Draw a centre-line and centre-punch the middle. Mark 130mm either side of centre then drill and tap the three holes (1/4" Whitworth).

Cut two pieces of 25 x 3mm bar 380mm long. Scribe a centre-line and centre-punch. Mark 130mm either side of centre and drill three clearance holes. Take one length of 415mm bar, face it running away from you and weld a piece of 12.5 x 3mm bar 15mm long to the front righthand side ensur-

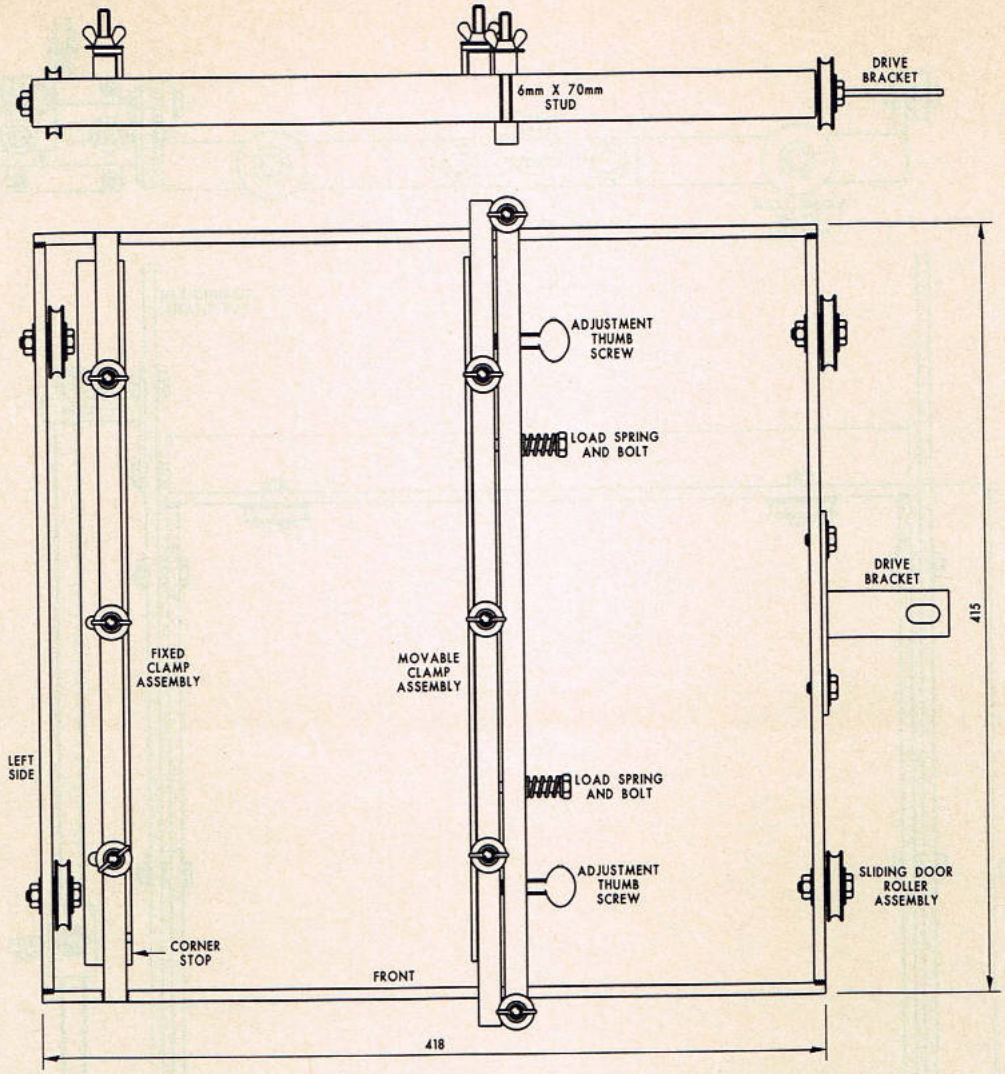


Fig.9: the Y-table carries a moveable clamp assembly, to secure the job. (Drawing scale 1:4).

ing that there is no weld on the inside. This becomes the corner stop. Now bolt the 380mm bar to the bottom of the 415mm long 12.5 x 12.5mm bar, using three 1½" bolts. This is the job support assembly.

Cut six pieces of bar 12.5 x 3mm 15mm long, then scribe the centre-line and a point 7mm from one end on each. Centre-punch and drill a 1/4" clearance hole in all six pieces. Place one of these pieces on each of the three bolts on the 415mm bar and secure them with nuts.

Cut two pieces of 12.5 x 3mm plate 360mm long and weld one to the three plates 5mm away from the corner stop. This assembly becomes the fixed clamp which is welded parallel to the wheels, with its outside edge 32mm from the outer edge of the Y-table frame. Remove the nuts from the three bolts and fit a washer and wing nut to each.

Moveable clamp assembly

Cut three lengths of 12.5 x 12.5mm bar 445mm long. Take one bar and as a first step, using the pieces already cut and drilled, make a mirror image of the fixed clamp assembly (just described) but without the corner stop piece.

Now pull it apart and draw a centre-line on its face at rightangles to the top. Centre-punch 90mm either side of centre and drill and tap each hole (1/4" Whitworth), then reassemble.

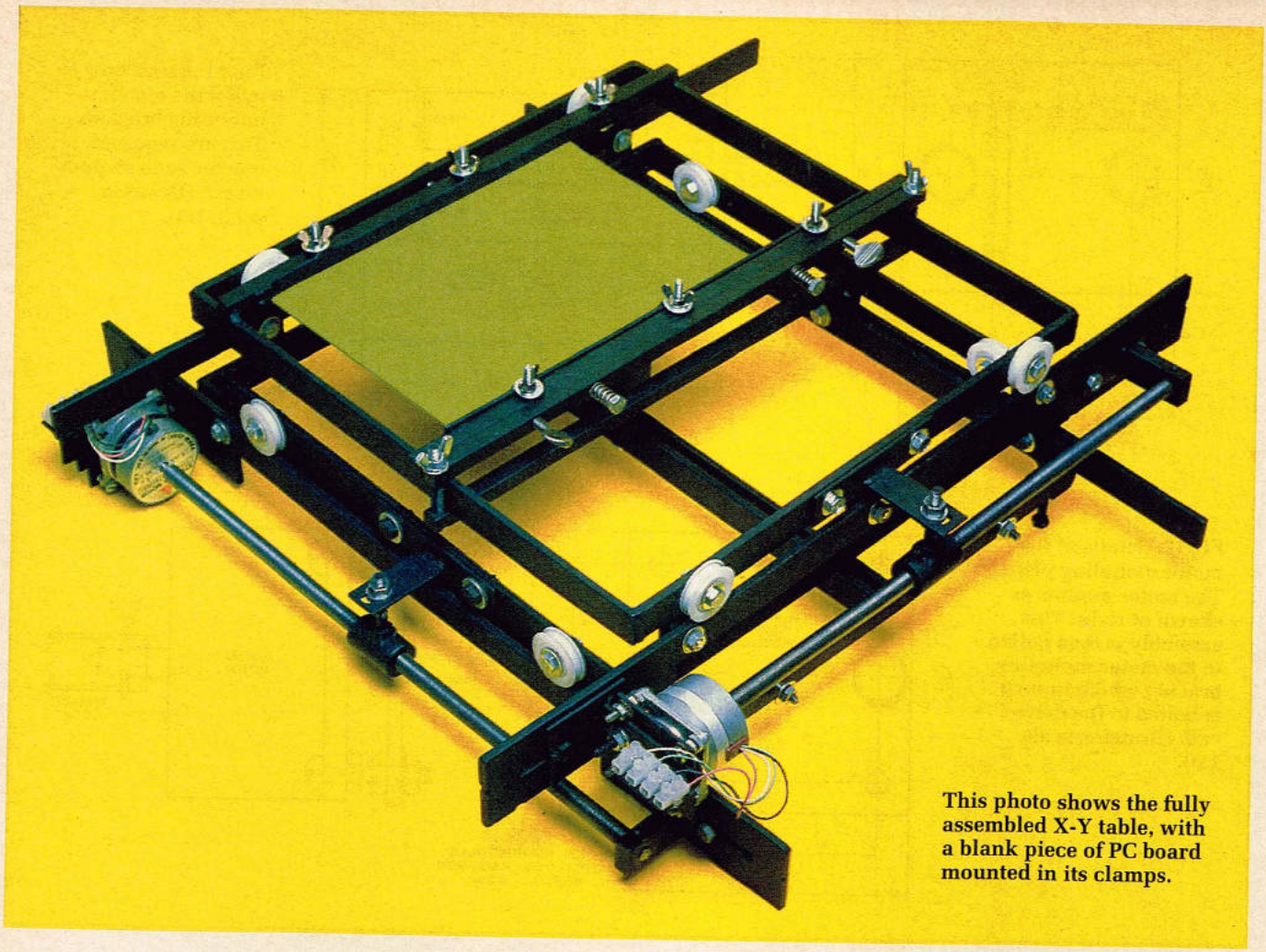
The other two 445mm bars should have holes marked 6mm from each end. Drill one bar at both ends and insert a 2½" bolt in each end and weld the heads to prevent them turning.

Drill the third bar with 1/4" clearance holes and scribe a centre-line on the face at rightangles to the top. Drill 1/4" clearance holes 90mm either side of centre, then drill and tap (1/4" Whitworth) holes 140mm each side of centre.

Now fit the load springs onto the bolts and screw them into the moveable clamp bar. Then fit the two 1/4" x 1" Whitworth thumb-screws for the fine adjustment.

Drive brackets

The next step is to make two drive brackets, one for the X-table and one for the Y-table. The details are shown



This photo shows the fully assembled X-Y table, with a blank piece of PC board mounted in its clamps.

in Fig.10. Cut two lengths of 25 x 3mm bar 110mm long and mark the centre-lines. Mark 40mm either side of the centre-line and drill the holes.

Cut two pieces of 25 x 3mm bar 60mm long, scribe a centre-line and centre-punch 9mm and 13mm from one end. Drill 5/16" holes and file them out to a slot. The slotted pieces are then welded to the centre-line of each 110mm bar.

Motor mounting brackets

These are shown in Fig.11. Cut two lengths of 50 x 3mm bar 60mm long, then mark and drill a hole 10mm from each end. Cut four pieces of 12.5 x 3mm bar 63mm long and two pieces 32mm long. Weld two sets of three plates, as shown and then grind off the excess weld. Weld each of these to the 60mm plates. Then fit and tack weld the two 1" bolts as shown.

Motor mounting plates

Cut two plates 62 x 62 x 3mm (or

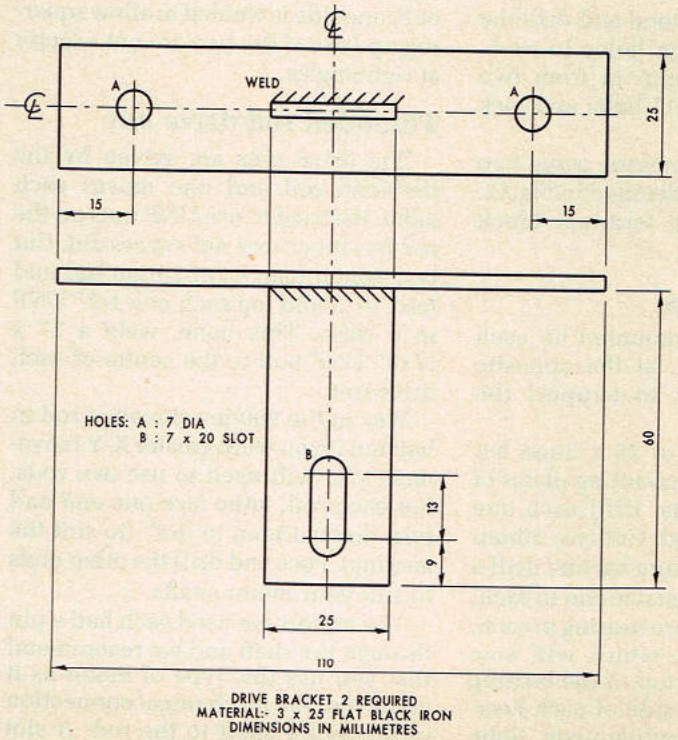


Fig.10: the drive bracket details. Two are required, one for the X-table and one for the Y-table. (Drawing scale 1:3).

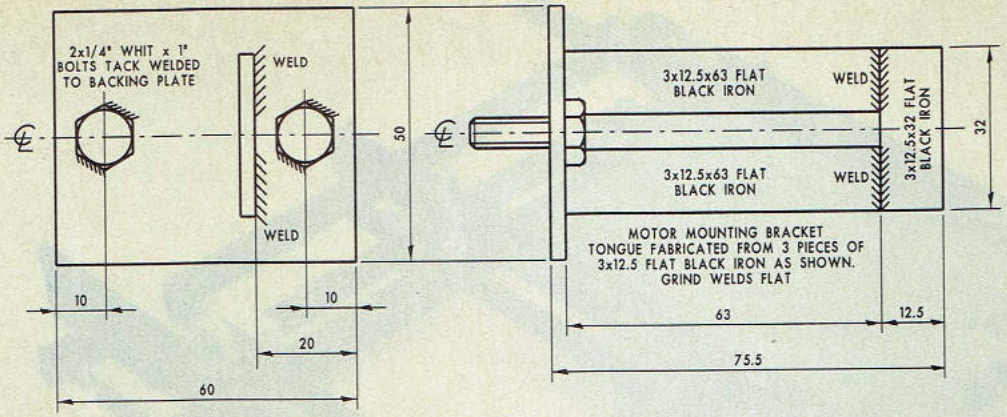
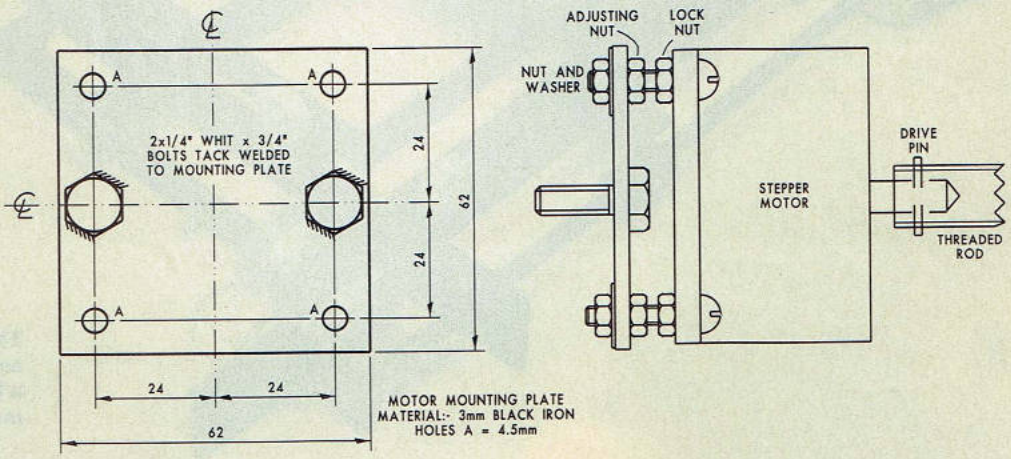


Fig.11: here's how to make the motor mounting brackets. Two are required, one for each stepper motor. (Drawing scale 1:3).

Fig.12: details of the motor mounting plate. The motor mounts as shown at right. This assembly is then bolted to the motor mounting bracket which in turn is bolted to the drive rail. (Drawing scale 1:3).



size to suit your motors) and drill the four motor mounting holes in each. Drill two holes 10mm in from two edges, then fit two 1" bolts and tack weld the heads.

Now mount the motors, using two nuts as adjusters as detailed in Fig.12. Fabricate and fit a terminal block bracket if you wish.

Bearing brackets

One of these is mounted on each motor running rail, at the opposite end to the motor, to support the threaded rod.

Cut two lengths of 25 x 3mm bar 60mm long for the mounting plates of the bearing brackets. Drill each one 10mm from one end. Cut two 50mm lengths of 12.5 x 25mm bar and drill a 1/2" hole 12mm from one end in each. Fit a phosphor-bronze bearing in each.

Drill an oil hole, which will now make this side the top of the bearing bracket. Weld one side of each bearing holder to a mounting plate. Note: only one side is welded to allow squaring up later if the two are not exactly at rightangles.

Threaded rod drive nut

The drive nuts are driven by the threaded rod and one moves each table. We tried to use UNF nuts on the rod but they were not successful. Cut two 40mm lengths of 25mm rod and face, drill and tap each one 1/2" UNF in a lathe. This done, weld a 2" x 5/16" UNF bolt to the centre of each drive nut.

We cut the 900mm threaded rod in half but if you want greater X-Y movement you will need to use two rods. For each rod, lathe face one end and turn down 13mm to 3/8" (to suit the bearing). Face and drill the other ends to suit your motor shafts.

The motors we used each had a pin through the shaft and we recommend that you use this type of motor as it simplifies the mechanical connection of the motor shaft to the rod. A slot was cut with a hacksaw, to allow the rod to push on over the pin.

Final assembly

If you have tested and adjusted each table to run smoothly as you built it, the next stage is to align the motors so that the threaded drive rods are parallel to the frames, for both the X and Y axes. Don't forget to fit the drive nut onto the threaded rods before you make these adjustments.

Now insert the drive nut bolts into the drive brackets and tighten the nuts with your fingers. You can now turn the rods by hand along the full traverse length, checking for smooth operation of the X and Y tables. Make any adjustments then nip the nuts tight with a spanner.

In the next article, we will describe how to wire the motors and power supply to the stepper motor cards and detail the Z-axis support. This support will carry a drill, plotter pen or whatever. SC

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SEE 99 CAT PAGE 221 FOR SPECS.

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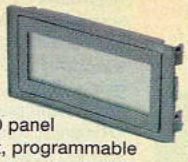

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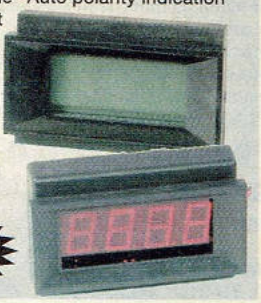

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Refer: SC May 99.

NEW

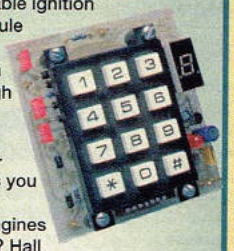
Test your electric fence easily with this 'mini' electric fence tester that fits into your pocket. The PCB that measures only 45 x 20mm has two contacts - simply hold one contact & place the other onto the fence wire. The on-board neon indicator will flash with each electric pulse. Kit supplied with PCB, electronic components and clear heatshrink. Now there is no need to use the wet blade of grass.
Cat. KC-5267 **$4.95**

'Maxi' Electric Fence Tester Kit
Refer: SC May 99.

NEW

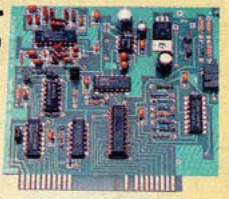
See that your electric fence is operating without leaving the house or having to cross that muddy field. It fits permanantly onto your electric fence and emits a bright flash from its on-board Xenon flash tube each time the electric fence pulses. Fitted into a transparent enclosure & is connected to the fence and to ground. Supplied with PCB, clear enclosure, Xenon flash tube and all electronic components. 2 fence clips required. Cat. KC-5269 **$23.95**

Programmable Ignition Kit
NEW



Refer: SC June 99. This programmable ignition timing module used in conjunction with our high energy ignition module KC-5247 allows you to program timing of engines with points? Hall effect or reluctor distributors well as many other features. The programmable ignition was originally introduced in March 96 by Silicon Chip magazine and has proven to be a huge success. Because many revisions have occurred since its release, Silicon Chip has now re-written this article explaining clearer construction and connection, incorporating all of the past improvements. Kit includes PCB, keypad, 7-segment LED display, pre-programmed microprocessor & all electronic components. Join the thousands that have benefitted from this superior project.
Cat. KC-5202 **$65.00**

FM Radio Tuner Card Kit for your PC
NEW

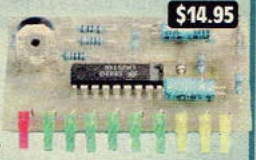


Ref: SC 5/99 Experience the tunes of FM radio coming from your computer system. This neat project fits into a vacant ISA slot inside your computer. You can tune the FM band (mono only) between 88-108Mhz, pre-set your 3 favourite channels and control the volume, using the free software available from the Silicon Chip web site. It runs fully independent of your sound card using its own in-built amplifier. Simply slot it into the computer, plug in the speaker, run the software then you can listen to the radio while you work. Kit supplied with plated through PCB and all electronic components.
Cat. KC-5270 **$45.00**

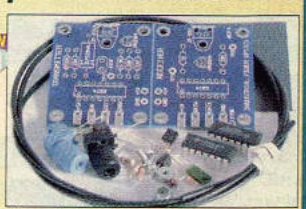
PIC Trainer With 5-Functions
NEW '99

Measure temperature & humidity, build a timer / counter, or do analogue to digital conversion with this 5 in 1 PIC trainer. Ideal for those who wish to learn about PIC microprocessor and LCD technology. Cat. KD-6060 **$109**

Car Battery Monitor
Refer: E A May 1987. Don't get caught with a flat battery! 10 coloured rectangular LEDs tell you your batteries condition. Kit includes PC board and all components. Cat. KA-1683 **$14.95**



Fibre Optic Communication Kit
NEW '99



This kit gives you a hands on introduction to fibre optics. It contains all the components needed to build a fibre optic data link, both transmitter and receiver, including one metre of fibre optic cable & fantastic quality double sided plated-thru PCB's. Cat. KF-4810 **$39.95**

Gas/Volatile Fume Detector
NEW '99

Detect gases such as alcohol, acetone, benzole, propane and carbon monoxide (contained in smoke from fires). Perfect as an alarm for gases and fire, or to detect alcohol on your breath. Kit includes Kwik Kit PCB, gas sensor and socket, 3A relay and all electronic components.
Cat. KG-9178 **$34.95**

8W + 8W Stereo Amplifier
NEW '99

This amplifier is conveniently powered from 6-15V DC. It produces 8-watts per channel and can drive loads between 4-16 ohms. Cat. KG-9036 **$32.95**

Electro-Educational Set
NEW '99

No soldering required! This educational construction set will teach novices about electromagnetism, by building 7 projects such as an electromagnet, generator, radio transmitter. Kit includes motor, lamp, compass, pre-wound coil, zinc nail, copper strip and cable. Cat. KG-9134 **$17.95**

Miniature FM Transmitter

This unit is a two transistor two stage transmitter that has the benefits of being VERY COMPACT. Contains all specified parts & makes an inexpensive beginners kit. Cat. KE-4711 **$10.95**

Screecher Car Alarm MKII

Unlike conventional car alarms, this unique design calls for the siren to be mounted inside the vehicle, the 'shrill' making it impossible for a thief to persist in stealing the vehicle or its' contents.
Cat. KA-1813 **$29.95**

JV60 6" 3 Way Speaker Kit
Refer: S C August, 1995

JV60 COME UP TRUMPS: Recently the Audio Society of WA had a "Great Speaker Comparison". The speakers compared were:-
- Vanderstaan 2C $3,800
- KEF 103/4 $3,700
- Whalmough 202 $1,900
- Vifa JV60 $849

The winner by a huge majority was the JV60's Craig Balmer (President) said "Excellent on all types of music. I do not know of any other speakers that offer the same value for money!"

BUY TOGETHER AND SAVE $29

SPEAKER KIT Includes 4 woofers, 2 tweeters, 2 crossovers with polyswitches, rear terminals, ports, innerbond and self tapping screws for mounting speakers and crossovers

CABINETS These are fully built and finished in black "blackwood" veneer. Grills supplied with speaker cloth mounted. You simply solder the crossover wires & screw the speakers in. For individual specifications on each driver see our speaker section.

SPEAKER & CROSSOVER	Cat. CS-2560	$579Pr
PREBUILT CABINETS	Cat. CS-2562	$299Pr
COMPLETE KIT		$849Pr

JC-30 6" 2-Way Bookshelf Speaker Kit
Refer: Electronics Australia February 1997

Quote from Rob Evans - Electronics Australia
At an all up kit price of just $429 a pair, these two way kit speakers from Jaycar may well represent about the best value-for-money around in high performance bookshelf loudspeakers.

BUY TOGETHER AND SAVE $29

SPEAKER KIT Includes: 2 x 6" Re/Sponse carbon fibre woofers, 2 x Vifa D19 dome tweeters, 2 x pre-built crossovers, Jaybond dampening material, screws, rear terminals, the cabling for inside box and ports. Cat. CS-2590

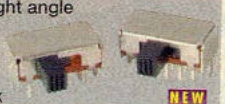
CABINETS Includes: 2 x pre-built cabinets finished in black/grey oak finish with speaker cloth mounted. Cat. CS-2596

SPEAKER KIT	Cat. CS-2590	$295Pr
CABINET KIT	Cat. CS-2596	$199Pr
COMPLETE KIT		$429Pr

OVERNIGHT DELIVERY

PCB Slider Switches

These minature PCB right angle switches match each other. There are 2 available. Both the same size. Body 13(L) x 4(H) x 7(D) mm excluding pins & actuator.



SWITCH 1 DPDT (on/off) Cat. SS-0830

SWITCH 2 3PDT (3 position) Cat. SS-0832

50c each

FM Wireless Intercom

These are great for homes, between garage, workshop, office and house, between rooms, grandparents upstairs, next door neighbours, etc. The built-in monitor control allows you to put one in the childrens room which transmits continuously, telling you when the babies are crying. Just plug into 240V power points.

Cat. AI-5500

$79.95PR

Heatsink Deal

This heatsink is drilled for 2 x TO220, but could be used for any flat pack device. It measures 80(L) x 32(D) 44 with mounting brackets x 27(H)mm. It has 10 fins, and is anodised black. Manufacturers, send us a fax on your letterhead for a free sample. Cat. HH-8518

$2.50 or $125 100 PCS inc tax

10" Clock with Humidity & Temperature

Cat. XC-0112

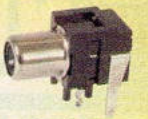
was $19.95

JUNE $15

save $4.95

PC Mount RCA Socket

RCA right angle socket. Cat. PS-0279



BUY 1 40c ea

BUY 100 25c ea

Laser Module

Includes laser diode mounted on a PCB with a battery spring and on/off switch. Simply connect 3 x 1.5V batteries -1mw output. Cat. ST-3115

$13.95

LCD Learning Remote Control

Retire up to 10 remotes! The ultimate! So many features! Macro allows you to program up to 20 codes at once! See 99 Cat. page 217 for details. Cat. AR-1708

$129.95

5 in 1 Learning

also available

Cat. AR-1706

$79.95

JayTech Slimline Telephone

*Back in Stock

Features include:

- Desk or wall mounting
- Tone or pulse switchable dialling
- Redial button
- Ringer on/off switch.

Cat. YT-7040

$28.95

12V Active Colour Antenna

UHF/VHF/FM IDEAL FOR CARAVANS, CARS, CAMPING & HOUSES WITHOUT 240VAC MAINS!

Contains a built-in amplifier that operates from 12VDC. It can be powered from the vehicle's battery and/or use it at home with the optional AC mains adaptor. (MP-3002). Cat. LT-3170

$59.95

Kids TV Remote!

Give the kids this TV remote, and put the good one away! Cat. AR-1702

$24.95

Auto 240V Backup Power Supplies

These Line-interactive automatic backup supplies are *sometimes incorrectly called Uninteruptable Power Supplies (UPS) ours are designed for personal computers (Apple, IBM PC etc), and are available in two different sizes - 400VA & 800VA. The ABS basically consists of a 240VAC inverter which is powered from a battery when the power fails. The batteries are of the Sealed Lead Acid type (SLA). Switchover from mains power to backup power is automatic (<4ms) and does not require user intervention. Software requires a spare COM port and IRQ to function. An average system will stay powered approx. 4 minutes for 400VA model, and 10 minutes on 800VA - usually enough time to save work and close Windows normally.

400VA	Cat. MP-3095	$249
800VA	Cat. MP-3096	$399

Wireless CCD Camera System

This versatile CCD system is wireless - it transmits audio and video on UHF up to 150 metres (line of sight) - less if there are walls to go through. Supplied in a strong and handy PLASTIC carry-case, all parts are provided so that you can be monitoring the vegie patch, baby's room, front door - anything! - in just a matter of minutes. The receiver unit has audio / video output for connection to a monitor / VCR, and features an easy-to-use "On-screen control". Kit contains: •1xReceiver / Switcher unit •1xWireless CCD camera •2xHigh-gain rubber-ducky aerials •2xAC/DC Plug-pack power adapter •1xRCA cable set and adapters for connection to monitor / VCR Cat. QC-3445

THIRD EYE

$599

SLA Battery Carry Bag

Use it to power any portable device that accepts external DC power. e.g. laptop computer, video camera, transceivers, even your favorite spotlight! Suits sealed lead-acid batteries 12V 7.0AH (SB-2486) or 6V 12AH (SB-2497) Features fused cigarette-lighter socket (10A), zip-up cover. Cat. HB-6360

$17.95

IS YOUR CAR ALARM REMOTE NOT WORKING TOO WELL?

Problem solved! This key fob transmitter will learn the code of your transmitter. Brand name replacements are very expensive, and sometimes impossible to get. This will solve your problem. It can actually learn up to 4 different frequencies, so it can be programmed for the car alarm, the garage door, home alarm etc, etc. Supplied with full instructions. Cat. LA-8990

Not suitable for code hopping remotes

$39.95

New Jiffy Boxes

Features - Pilot holes on the lid inside for drilling and cutting. Hole plugs to cover screw holes. For details see 99 Cat. page 119. Manufacturers - contact us for great bulk prices.

Cat. HB-6011	$3.95
Cat. HB-6012	$5.95
Cat. HB-6013	$3.50
Cat. HB-6015	$2.50

Removeable Hard Disc Carrier with Frame

Make your IDE hard disk drive transportable to any computer with a frame / cradle installed. The cradle is easily installed in a standard drive bay, with the hard disk drive mounted inside the removable frame. A key lock is provided. See 99 Cat. page 190 for full details. IDE KIT Cat. XC-4670

was $39.95

MAY $29.95

save $10.00

ISOPROPYL ALCOHOL CLEANING PADS

Isopad cleaning pads will remove contaminants from metal, plastic and painted surfaces. Also ideal for cleaning computers. Cat. NA-1060

PKT OF 10 $3.95

DON'T FORGET TO VISIT OUR WEB SITE: www.jaycar.com.au

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

50 Amp Car Stereo Noise Filter

If you have more than the "normal" car stereo system you may need this filter. It consists of a huge (80 x 70 x 50mm) choke and one 4700uf capacitor. Supplied with instructions. Inductance 0.3mH. Cat. AA-3078

was $24.95 save $4.95 NOW $20

4A Car Battery Charger

NEW 99

This low cost charger will keep your batteries in top shape. It delivers 4 amps, and reduces the charge to the battery as it becomes fully charged. Two LEDs on the unit advise power, and full charge. Cat. MB-3520

$39.95

Passive Infra Red & Microwave In 1

Made in Japan. The ultimate in PIRs for home & warehouse burglar alarms. Requires both the PIR and microwave to be triggered at the same time, virtually eliminating false alarms. **Were selling for $99.50 in 1996!**

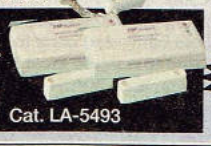
10m range for home Cat. LA-5012
Buy 1 for $55 ea
Buy 4 for $50 ea

15m for hallway or warehouse Cat. LA-5013
Buy 1 for $60 ea
Buy 4 for $55 ea

Wireless Home Alarm System Deal!!!

System includes 4 sector control panel, wireless PIR, wireless remote control, wireless read/magnetic switch & power supply. See 99 Cat. for details. Cat. LA-5490

JUNE SPECIAL
With every system sold, receive FREE 2 extra wireless reed/magnetic switches (worth $95.90) Cat. LA-5493



$329.50

EASY START CAR JUMP CHARGER

This device works via cigarette lighter sockets. It takes some charge from the good battery, and gives it to the bad battery. 5 mins min. time required. Cat. MB-3595

was $29.95 save $9.95 NOW $20

BUY 10 LESS 10%

Connector Lead Giveaway!!!

STOCK UP, LIMITED QUANTITY AVAILABLE

AUDIO LEADS

3.5mm Stereo Plug to 3.5mm Stereo Socket
3.0 m. Cat. WA-1023
was $4.95 Now $2.95 save $2.00

3.5mm Stereo Plug to 2 x RCA Plugs
1.2 m long. Cat. WA-1024
was $4.95 Now $2.95 save $2.00

6.5mm Stereo Plug to 6.5mm Stereo Socket
Curly Cord 2.5 m long. Cat. WA-1005
was $5.95 Now $3.50 save $2.45

2 RCA to 2 RCA Plugs
1.2 m long. Cat. WA-1042
was $3.50 Now $2.50 save $1.00

3.0 m long. Cat. WA-1044
was $6.95 Now $3.50 save $3.45

2 x Gold RCA Plugs to 2 x Gold RCA Plugs
1.2 m long. Cat. WA-1046
was $5.95 Now $3.95 save $2.00

4 RCA Plugs to 4 RCA Plugs
1.2 m long. Cat. WA-1003
was $6.95 Now $4.50 save $2.45

COMPUTER

D25 Male to D25 Male
2 m long. Cat. PL-0856
was $7.95 Now $5.95 save $2.00

D25 Male to Centronics
2 m long. Cat. PL-0854
was $7.95 Now $5.95 save $2.00

D25 Male to D25 Female
2 m long. Cat PL-0855
was $9.95 Now $6.95 save $3.00

6 Pin Male Mini Din to 6 Pin Female Mini Din
2 m long. Cat. PL-0931
was $9.95 Now $6.95 save $3.00

USB 4 Pin (A) Male to USB 4 Pin (B) Male
1 m long. Cat. PL-0925
was $12.95 Now $5.95 save $7.00

2 m long. Cat. PL-0926
was $14.95 Now $7.95 save $7.00

GUITAR LEADS

6 Metre Curly Cord with 2 x 6.5mm Gold Plugs
This is a heavy duty coiled cable with heavy duty gold 6.5mm plugs on either end. Cat. WA-1051
was $14.95 Now $9-95 save $5.00

6 Metre 6.5mm Plug to R/A 6.5mm Plug
This cable uses extremely flexible, rubber insulated shielded cable. On one end is a quality metal 6.5mm plug with strain relief, and a right angle metal 6.5mm plug on the other. Cat. WA-1052
was $14.95 Now $9-95 save $5.00

3 Metre 6.5mm Plug to R/A 6.5mm Plug
This is 4mm diameter flexible screened cable & quality moulded 6.5mm plugs on either end - one right angled. Cat. WA-1053
was $4.95 Now $2-95 save $2.00

VIDEO LEADS

BNC - RCA
1.5 m long. Cat. AV-6521
was $5.95 Now $3.95 save $2.00

RCA - TV Coax Plug (Pal)
1.25 m long. Cat. AV-6590
was $3.95 Now $1.95 save $2.00

Pal Plug to Pal Socket
1.8 m long. Cat. AV-6582
was $4.50 Now $2.50 save $2.00

F59 Plug to Pal Plug
1.8 m long. Cat. AV-6592
was $4.50 Now $2.50 save $2.00

OVERNIGHT DELIVERY

Testing Loudspeakers by Joseph D'Appolito

Reviewed in Australian Hi-Fi May issue.
Chapter headings include: • Driver testing • Low frequency system electrical impedance tests • Accoustical testing of single drivers • Acoustical testing of multiple - driver systems • Time, frequency and the Fourier Transform •Loudspeaker testing with PC based accoustic data acquisition systems. This book was reviewed in Speaker Building Magazine No. 6, 1998. These are exerpts from the review: "The book fills a real void in technical literature and is packed with useful information. Chapter 2 alone is worth the price of the book. If you are seriously interested in loudspeaker testing. Order a copy." Softcover 280 x 215mm. 174 pages. Cat. BA-1420

$69.95

Coloured Compact Disk Jewel Cases

NEW 99

Packet of 5, one each of blue, green, yellow, orange, pink. Cases are clear so y0u can see through. Cat. AR-1465

$6.95

You're Choking!

We thought this was a tranny at first. Further inspection revealed that it is in fact a heavy duty DC Choke. It would be rated to carry 15A DC easily. Our bridge measured them at 0.78mH or 78µH. This would make them pretty handy for ripple suppression in car audio. There is more to it than that though. They are really beautifully Swedish made. They have machine threaded end plates & can be dismantled easily. You could easily pull the thing apart & wind another value choke or even a transformer (taking care to remove the air gap spacer in the laminations. 60(W) x 50(H) x 45(D). Cat. AA-3082

ONLY $10ea

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

Acoustic Sound Absorbing / Deadening Materials

Ideal for car sound installations.

Heavy Duty Sound Barrier / Damping Material

This is basically a flexible plastic-like material that forms an attenuating / reflecting sound barrier. It is ideal for any surface that needs to be "deadened". It completely damps (ie prevents) any panel resonating from high power speakers. It is also amazing for attenuating road noise from steel car floors, etc. It can be cut with a hobby knife or good scissors etc. One sheet is generally enough for the average car door. •Sheet size 700 x 330 x 2.3mm thick (approx)
Cat. AX-3680

SHEET $8.95

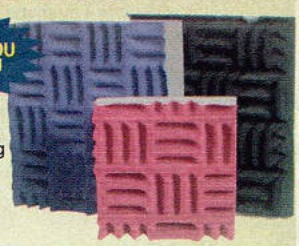
Heavy Duty Sound Barrier / Absorbing Damping Material

This material is similar to Cat. AX-3680 in that it is a sheet of 4kg loaded vinyl, but has on one side a layer of sound absorbing felt. The felt will absorb sound, not reflect it, while the vinyl damps vibrations. It can be laid under carpet, around firewalls, between door trim and car doors etc to insulate sound from outside - and noise from your sound system to outside! •Sheet size 680 x 330 x 4.5mm thick (approx) Cat. AX-3682

SHEET $14.95

Sound Absorbing Acoustic Tiles

DON'T FORGET IF YOU BUY 10 YOU GET 20



Ideal for; •Recording studios •Schools / Colleges •Radio/TV broadcasting •Aircraft noise •Machinery/loud noise attenuation •Home cinema •Standing acoustic wave problems •Tuning rooms for maximum Hi Fi •Anechoic chambers

This material is available in two thicknesses 25mm and 38mm. The tiles come as a nested pair (male/female). Each tile is 300 x 300mm and are made from fire retardant polyester urethane They can be spray painted and can be attached to virtually any clean, dry stable surface with double sided adhesive foam tape or contact type adhesive. Supplied in grey colour.

25mm TILE (300X300mm) NESTED MALE/FEMALE (2 TILES) Cat. AX-3652	$13.95 / 10 $12.50 / 100 $9.95
38mm TILE (300x300mm) NESTED MALE/FEMALE (2 TILES) Cat. AX-3656	$16.95 / 10 $14.95 / 100 $12.95

REFER PAGE 73 OF 99 CATALOGUE FOR FULL SPECS AND PAGE 256 FOR COMPLETE DATA.

FOSTER C100K03 4" WIDERANGE SPEAKER

They're back ! We have secured a small quantity of this fantastic speaker. Ideal for midrange and PA widerange. Specifications Impedance 8Ω, power handling 10WRMS, frequency response 80-17kHz. Sold for $21.50 in 1987!!
Cat. CE-2315

JUNE $22.95

Wireless Remote Control Extender

Ingenious device for extending the transmitting range of your infrared remote-controlled appliances in the home or office. Infrared commands from your remote control are transmitted by UHF (radio signal) to the receiver in another room - where they are converted back to infra red for the device(s) you want to control. Ideal for situations where you have a VCR playing in one room, and you watch the TV in another.
Cat. AR-1805

$119

SEE 99 CAT PAGE 221 FOR SPECS.

CAT 5 CROSSOVER PATCH LEAD

2 metre Cat 5 patch lead with wiring crossed over. Black in colour. RJ45 to RJ45
Cat. YN-8172

$12.95

2.0uf 250VDC Cap

Our normal price for these is $2.25 each. We've made a bulk surplus deal, and can offer these at well below normal price. They are white in colour, size 31(L) x 10.5(W) x 20(H)mm. Lead spacing 27mm, lead length 18mm.
Cat. RG-5176 PKT 10 $7.95
Cat. RG-5177 PKT 100 $59

POLYCARBONATE CASE BARGAIN

We have a limited quantity of these cases available at less than half price. Size 95 (L) x 48 (W) x 38(H)mm. Colour light grey. Normal price is be about $5.50 Cat. HB-5620

$2.50ea.

Design Speaker Boxes Fast and Accurately with BassBox Pro

See Cat P47 for full details.
Cat. XC-5020.

$299

COMPUTER MICROPHONE HEADSET

WAS $19.95
THEN $14.95

JUNE $9.00 Cat. AA-2028

NEW JAYCAR AUTHORISED DEALER GOLD COAST ELECTRONICS 2474 GOLD COAST H'WAY PH: 07 5526 0955

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ENQUIRY HOTLINE: (02) 9743 6144 FAX: (02) 9743 2066

ROAD FREIGHT ANYWHERE IN AUST (up to 20kg) $14.00

POST & PACKING $10 to $24.99=$4.00 $25 to $49.99=$5 $50 to $99.99=$7 OVER $100=$8

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PRODUCT SHOWCASE

Hioki thermometers for food applications

The new Hioki 3441/2 series of intelligent thermometers from Nilsen Technologies have a variety of probes including K-type sheaths and surface-type probes, making them highly suitable for use in food production and preparation.

For wet environments, the Hioki 3442 also has a one-piece moulded resin construction.

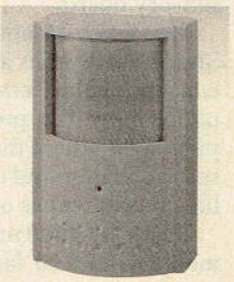
The thermometers will read from -100°C to 1300°C, making them suitable for use over a very wide range of applications, from liquefied gases to ovens and kilns.

Resolution from -100°C to +200°C is 0.1°C.

They can store maximum and minimum temperatures in the measurement time interval, and both maximum and minimums can be read at any time by pressing one button. The display can also be held for later review, especially handy in poor light conditions.

For more information, contact Nielsen Technologies, 150 Oxford St, Collingwood Vic 3066. Tel 1-800 623 350, fax 1-800 067 263.

Video Camera Hidden in a PIR Detector



Available from Allthings Sales & Service in Perth is a passive infrared (PIR) movement detector with an in-built concealed pinhole video camera.

The inconspicuous unit has the appearance and indeed functionality of an ordinary alarm system detector but also contains the camera, a microphone, preamplifier and programmable timer/counter which may be used to trigger an alarm, control lamps, switch on a video recorder and so on.

Three camera models are available; a Samsung b&w CCD version, a Sony CCD version suitable for low light, infrared or high resolution applications and a DSP (digital signal processing) colour camera.

All three produce better-than-VHS to near-Super-VHS quality images.

Operation is from 12V DC. Price is from $139 depending on camera.

For more information, contact Allthings Sales & Service, tel (08) 9349 9413, fax (08) 9344 5905 or visit their website, www.allthings.com.au.

Vass 250W sinewave inverter

The low-cost LS250 inverter from Vass Electronics features a 12/24V DC input and a 600W overload capacity for turn-on surges. With a 230V sine wave output it is designed for the consumer market.

Contact Vass Electronics, 1/ 42-44 Garden Bvde, Dingley Vic 3172.Tel (03) 9558 0970, fax (03) 9558 0082.

Eurovox to make satellite vehicle guidance systems in Magellan deal

Eurovox, Australia's largest supplier of automotive audio entertainment systems to vehicle manufacturers, has recently signed an agreement with US-based Magellan Corporation to design, develop and manufacture satellite-aided in-vehicle navigation systems for the Australian and New Zealand markets.

As well as using the licenced Magellan vehicle navigation technology, Eurovox will also develop navigation equipment for original equipment manufacturers and importers plus commercial and consumer applications.

Eurovox will incorporate Magellan's latest turn-by-turn vehicle navigation and information technology which incorporates satellite positioning, patented inertial navigation capability and digital map-matching. This provides both visual and voice-prompted instructions for the driver.

Managing Director of Eurovox, Paul Miller, said that the deal with Magellan would mean that his company would now be able to provide the Australian automotive market with the very latest in mobile information systems.

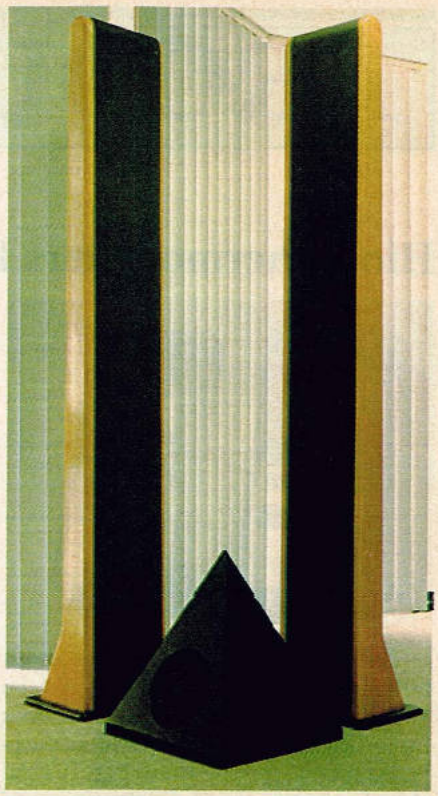
Eurovox boasts the most technically advanced production, engineering and R&D facility of its kind in Australia, with its own sheet metal and harness-making divisions.

Offering manufacturers and importers a total car audio design, development and manufacturing facility, Eurovox-built products are found in a large percentage of vehicles manufactured or sold in Australia.

For further information, contact Eurovox via their website, www.eurovox.com.

The Magellan website can be found at www.magellangps.com

$2990 Vass Electrostatic Speakers: "Price Breakthrough"



Victorian speaker manufacturer Vass Electronics has released a new electrostatic speaker with a recommended retail price of $2990 per pair, which it says compares well with other models costing $10,000 and more.

The speakers are nothing if not imposing. At 2.2m tall and weighing some 45kg, they are claimed to produce a well sustained bass response with the clarity and presence that only a true electrostatic speaker can provide.

Frequency response is 40Hz-20kHz with a sensitivity of 84dB/W. Impedance is 4Ω.

Each unit is based on two identical electrostatic panels with mechanically-separated bass and treble sections. The ultra-thin diaphragm has a moving mass equivalent to a sheet of air less than 3mm thick.

The hand-built enclosures are crafted from 32mm natural timber and each occupies a floor area of 0.4 square metres. A wide selection of custom timber finishes is available.

To complement the electrostatic speaker range, Vass has released a "pyramidal" subwoofer (also shown in the photograph at right). It is available in a passive version (for use with electrostatics) and a powered 200W active version (for use with conventional speakers). Constructed from 32mm MDF, the 50 x 50 x 50cm subwoofer features two 10-inch bass drivers in a 50 litre infinite baffle enclosure. -3dB point is at 30Hz, with -10dB at 20Hz.

Vass speakers are available through selected distributors Australia-wide. For more information, contact Vass Electronics Pty Ltd, Unit 1, 42-44 Garden Bvde, Dingley, Vic 3172. Phone (03) 9558 0970; fax (03) 9558 0082, email vass@hotkey.net.au

Master Chess with Voice Master Talking Chess Set

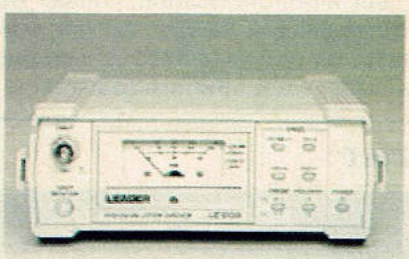
If you've ever wanted to master the finer points of chess, this could be the answer: a chess set which has an interactive voice teaching feature and a sensory board.

The Voice Master set is from Dick Smith Electronics and has two levels: a teach level where the computer explains how the pieces move, and a play level where the computer analyses each move and explains the possible consequences of a poor move.

There are 4000 moves built into the memory and 40 famous 'grand master' chess games pre-programmed in.

It runs on four 'AA' batteries and is priced at $99 (not including batteries) from all Dick Smith Electronics stores, by mail order or from the Dick Smith Powerhouse stores.

DVD/CD/MD Jitter Meter



Stantron Australia, distributors of Leader Instruments, have released a Jitter Checker designed for real time measurement of the jitter of 3T component in the EMF signal from DVD, CD and MD players.

The LE9139 is ideal for player maintenance applications and also checks minimum point of jitter during adjustment.

For more information, contact Stantron Australia Pty Ltd, Suite 1, Unit 27, 7 Anella Ave, Castle Hill NSW 2154. Phone (02) 9894 2377; fax (02) 9894 2386, email stantron@internet-australia.com

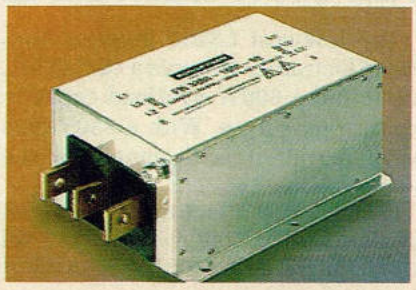
Tiny 2500A Filters

The new Schaffner FN3359 series of highly compact 3-phase EMC filters use an advanced LCR design which not only provides excellent filtering (meeting standard EN55011) but also exceptionally low leakage current – just 6mA.

They filters are tiny: the 1000A filter for example, measures 230x170 x350mm and weighs 18kg. Current range is from 150 to 2500A, voltage is selectable from 500 or 690V and they suit ambient temperatures up to 50°C.

The 150 and 250A models are provided with screw-type terminals; the other six models are fitted with busbar connectors.

For more details, contact Westek Industrial Products Pty Ltd, 2/6-10 Maria St, Laverton Nth Vic 3026. Phone (03) 9369 8802; fax (03) 9369 8006, email westek@projectx.com.au.



Improved 7-series family from Jamo

Jamo, the Danish-based hi fi speaker company marketed in this country by Jamo Australia, has recently upgraded their highly successful '7-series' speaker family.

There are six speakers in the range, from a very compact 310 x 180 x 265mm unit up to the 1055 x 260 x 385mm Jamo 7.7 Also included is a centre speaker intended for surround systems such as in home theatre.

In revising the range, the efforts of Jamo engineers have been concentrated in two main areas – new speaker technology and improved bass response.

All of the Jamo 7 series speakers now feature a proprietary woofer/midrange unit and a one-inch soft dome tweeter which Jamo claim to be virtually indestructible.

For more information on the Jamo range contact Jamo Australia on (03) 9543 1522 or visit their website at www.jamospeakers.com

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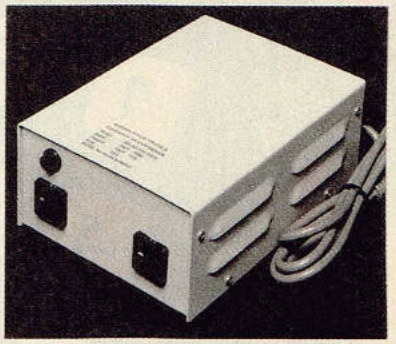

Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

EMC Immunity testing in labs & on site

The new Schaffner NSG 3025 is an extremely compact full-function burst generator, an essential part of EMC susceptibility testing required for products needing CE marking.

It is capable of generating pulses from 200V to 4.8kV, burst frequencies from 0.1kHz to 1MHz and 1 to 255 spikes per burst. It can be manually controlled or controlled via an RS232 link to a computer.

For more information contact Westek Industrial Products Pty Ltd, 2/6-10 Maria St, Laverton Nth Vic 3026. Phone (03) 9369 8802; fax (03) 9369 8006. **SC**

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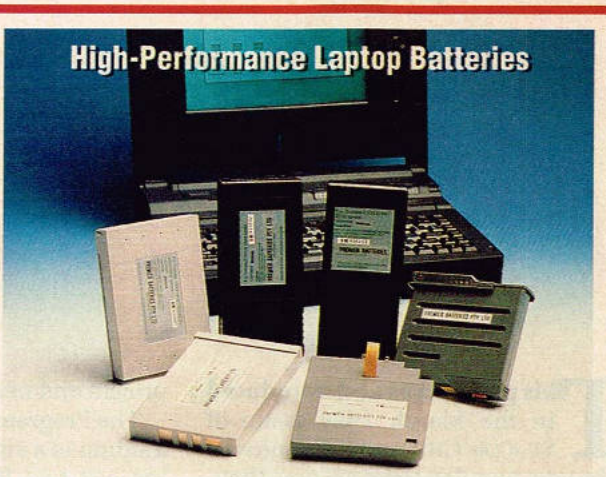

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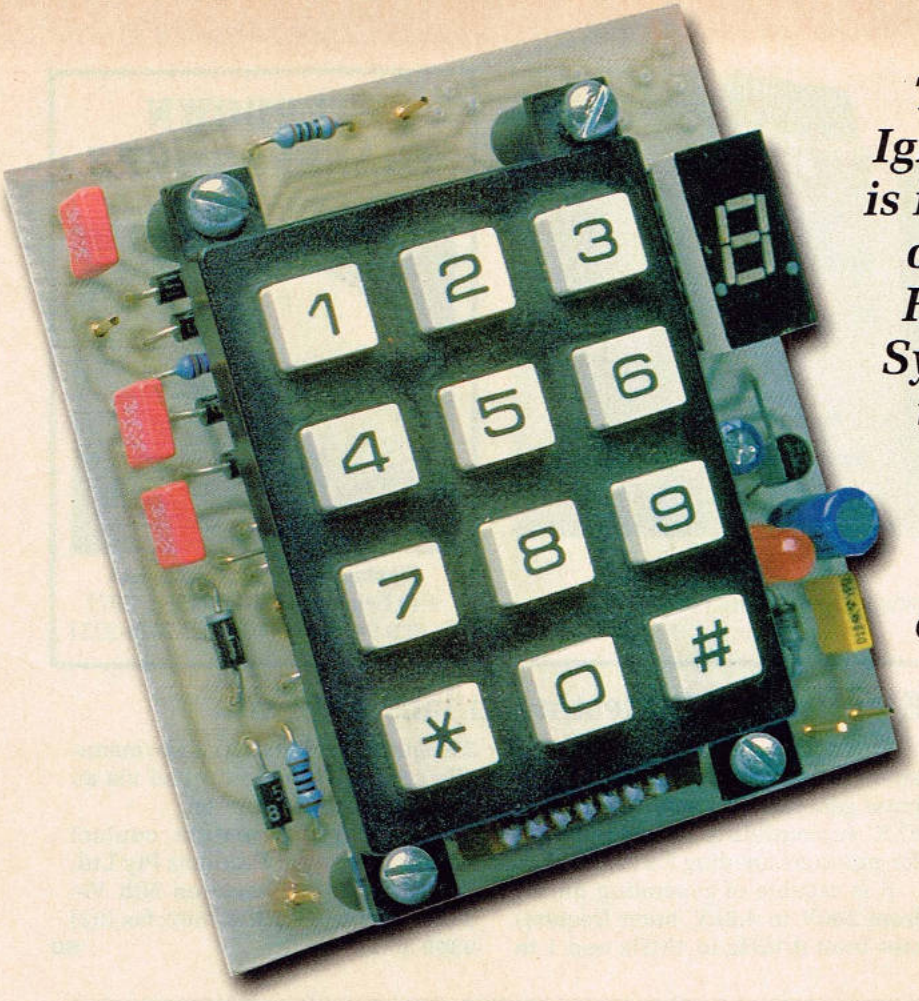


This Programmable Ignition Timing Module is intended to be used in conjunction with our High Energy Ignition System as described in the June 1998 issue. It allows you to program the ignition timing of engines with points, Hall effect or reluctor distributors.

By ANTHONY NIXON

PROGRAMMABLE IGNI

This project was first introduced in the March 1996 issue of SILICON CHIP and it has proven to be very popular: there are now thousands of units in use.

This article updates the project and clarifies the installation.

Since its introduction, the design and software of the Programmable Ignition Timing module have gone through a number of changes to improve performance and the High Energy Ignition system was also updated in the June 1998 issue.

These revisions have led to some confusion as to how the system should be connected and operated and this is why we have decided to update the project and completely re-present it.

The Programmable Ignition Timing module is a small PC board comprising just two ICs, a handful of other components, a keypad and a small display.

The simplicity and ease of construction of the circuit is made possible by using a PIC 16F84 microcontroller. Programming is simply a matter of entering data with the keypad while monitoring it on the display.

Nine parameters can be programmed into the module:

- The RPM at which ignition advance begins
- Mid stage RPM
- Mid stage advance
- RPM limit
- Rev limit advance
- Dwell angle
- Vacuum advance
- Number of cylinders
- A 2-digit security code

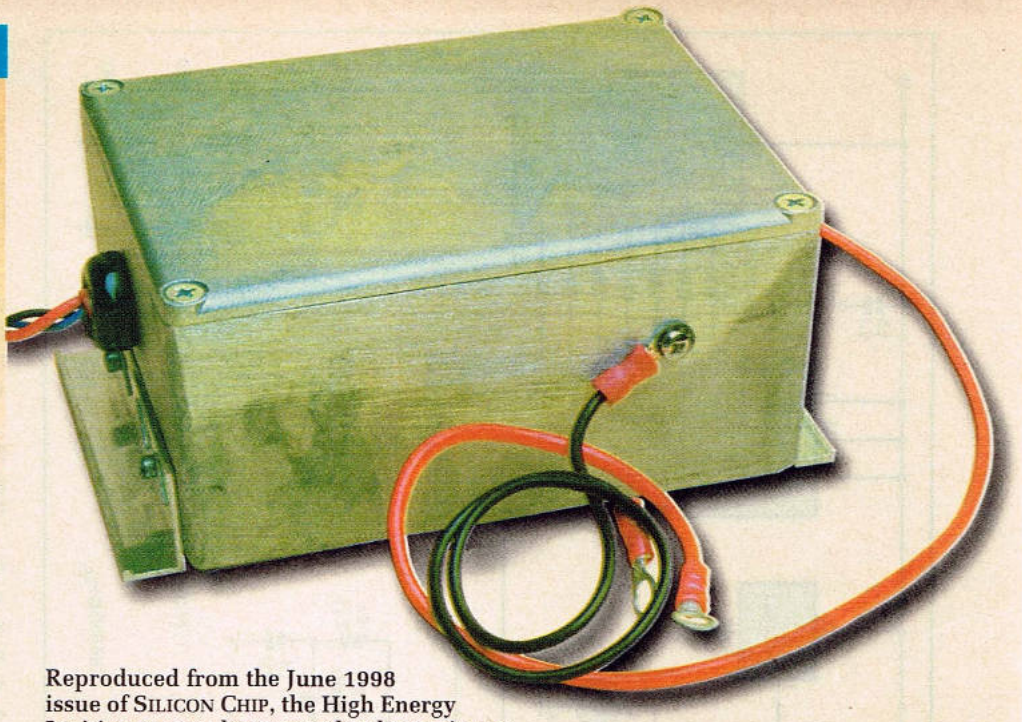
To make the module even more useful, the second stage advance can be either positive or negative and you can store two sets of data which can be alternated while the engine is running.

The benefit of this is that you can accommodate an engine that runs on petrol or LPG and quickly change the timing for these two fuels to get the best possible performance.

Please note that while this project

Main Features

- User programmable
- Two stages of advance
- Second stage advance can be positive or negative
- Keypad data entry
- Security coded (2 digits)
- Can store two sets of data
- Tachometer drive output
- Points or other sensor input
- Automatic coil cutoff if motor not running
- 7-segment LED display
- LED indicator for initial timing setup
- Preset RPM limiting



Reproduced from the June 1998 issue of SILICON CHIP, the High Energy Ignition system has proved to be a winner – very good performance and highly reliable. The programmable ignition timing module described here is designed to directly interface with this HEI, although it can be adapted to other ignition systems including the Multi-spark CDI described in September 1997.

TION TIMING FOR CARS

has been very popular, it is not intended for high performance vehicles, particularly those which already have engine management systems.

What it does

Fig.1 shows how the Programmable Ignition Timing (PIT) module is connected to the High Energy Ignition (HEI) system. In essence, the signal from the car's points, reluctor or Hall effect pickup in the distributor is conditioned by the input circuitry of the HEI system and we use the conditioned signal to trigger the PIT module. Depending on its programming, each time the PIT module receives a trigger pulse from the HEI, it delivers

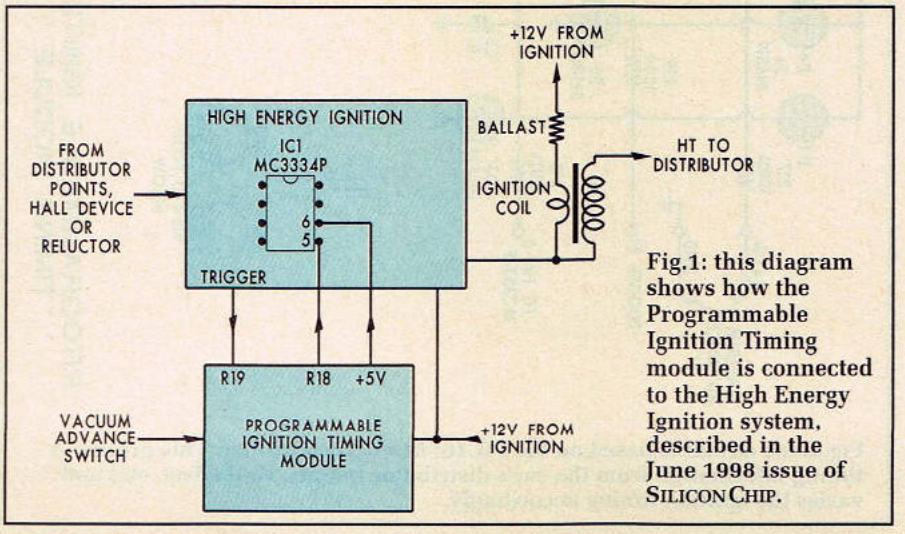


Fig.1: this diagram shows how the Programmable Ignition Timing module is connected to the High Energy Ignition system, described in the June 1998 issue of SILICON CHIP.

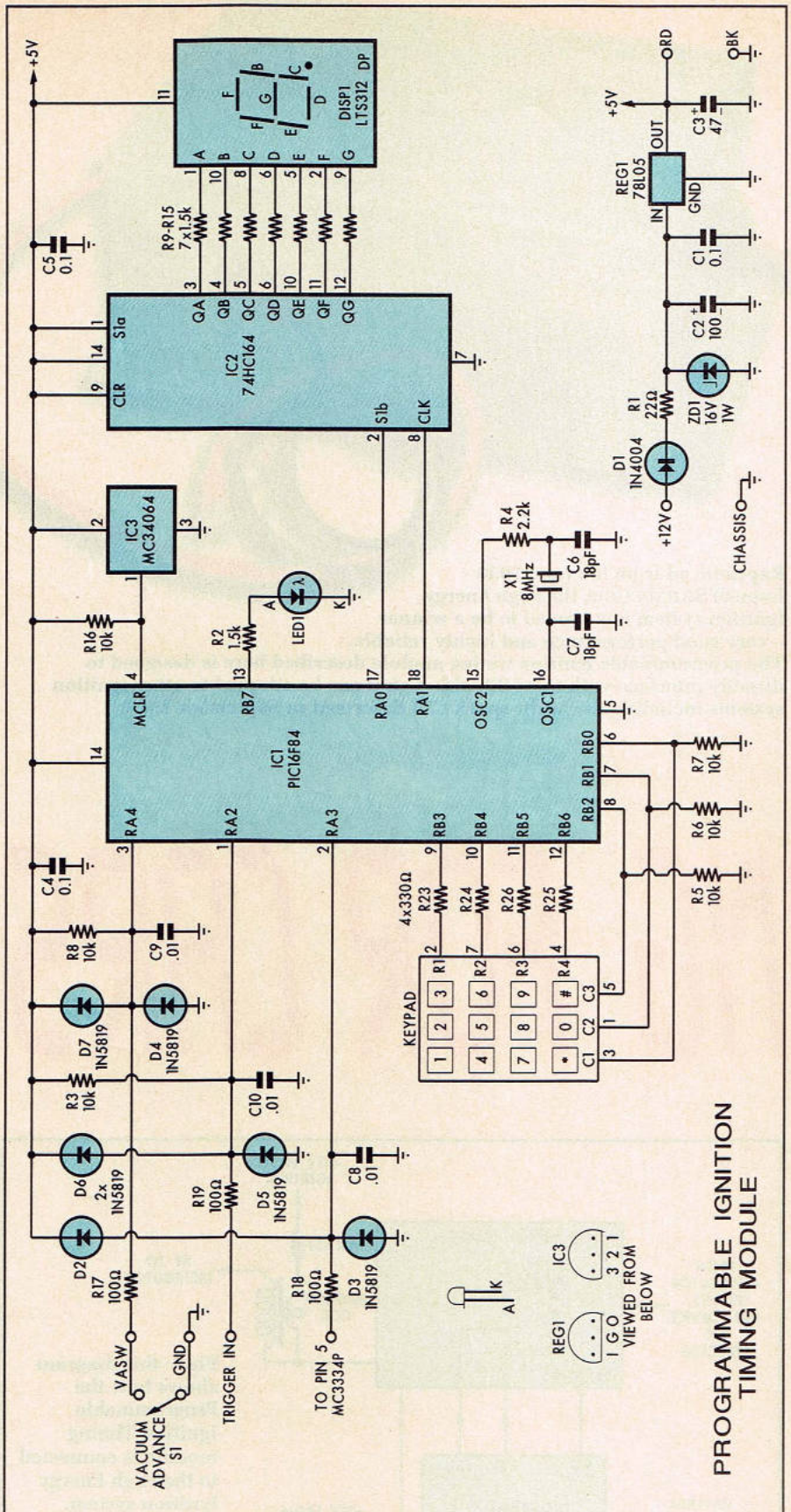


Fig.2: the circuit is based on the PIC16F84 microcontroller. This processes timing information from the car's distributor (points, Hall effect, etc) and varies the ignition timing accordingly.

a delayed pulse to the HEI system to fire the ignition coil.

Why are the ignition pulses delayed? In cars without engine management, the ignition timing (ie, the ignition advance curve) is controlled by centrifugal weights in the distributor.

These cause the ignition timing to advance as the engine RPM increases. In addition, a vacuum diaphragm actuator mechanically increases the advance as manifold vacuum rises.

When the PIT and HEI systems are employed together, the car's centrifugal advance mechanism is clamped in the fully advanced position.

To do this, the advance weight return springs are removed and the weights themselves are wired so they are held in the fully out position. In addition, the moveable vacuum advance plate must be clamped so that it can't move when the vacuum actuator is removed.

Since the distributor is locked in the fully advanced position, the PIT module must provide a variable time delay in order to allow the engine to start and run.

In practice, it provides quite a lot of delay when the engine revs are low and less delay when the engine revs are high. It also modifies the delay depending on whether the vacuum switch is open or closed.

How it works

Fig.2 shows the circuit of the PIT module. The heart of the circuit is the PIC 16F84 microcontroller. It calculates the delay period for each ignition pulse, according to stored data which has been previously entered via the numeric keypad.

The keypad has four rows and three columns (for 12 keys) and these are connected to seven inputs on the PIC, RB0-RB6; the columns to RB0-RB2 and the rows to RB3-RB6.

When operating, the PIC alternately takes its RB3-RB6 outputs high and low. When any key is pressed, this low is then sensed by one of the RB0-RB2 inputs and the PIC takes the appropriate action.

For example, if key "0" is pressed, then when RB6 is pulled high, it is connected through the key to RB2, which is normally held low by resistor R5.

RA4 (pin 3) is the vacuum advance input and S1 is a microswitch that is

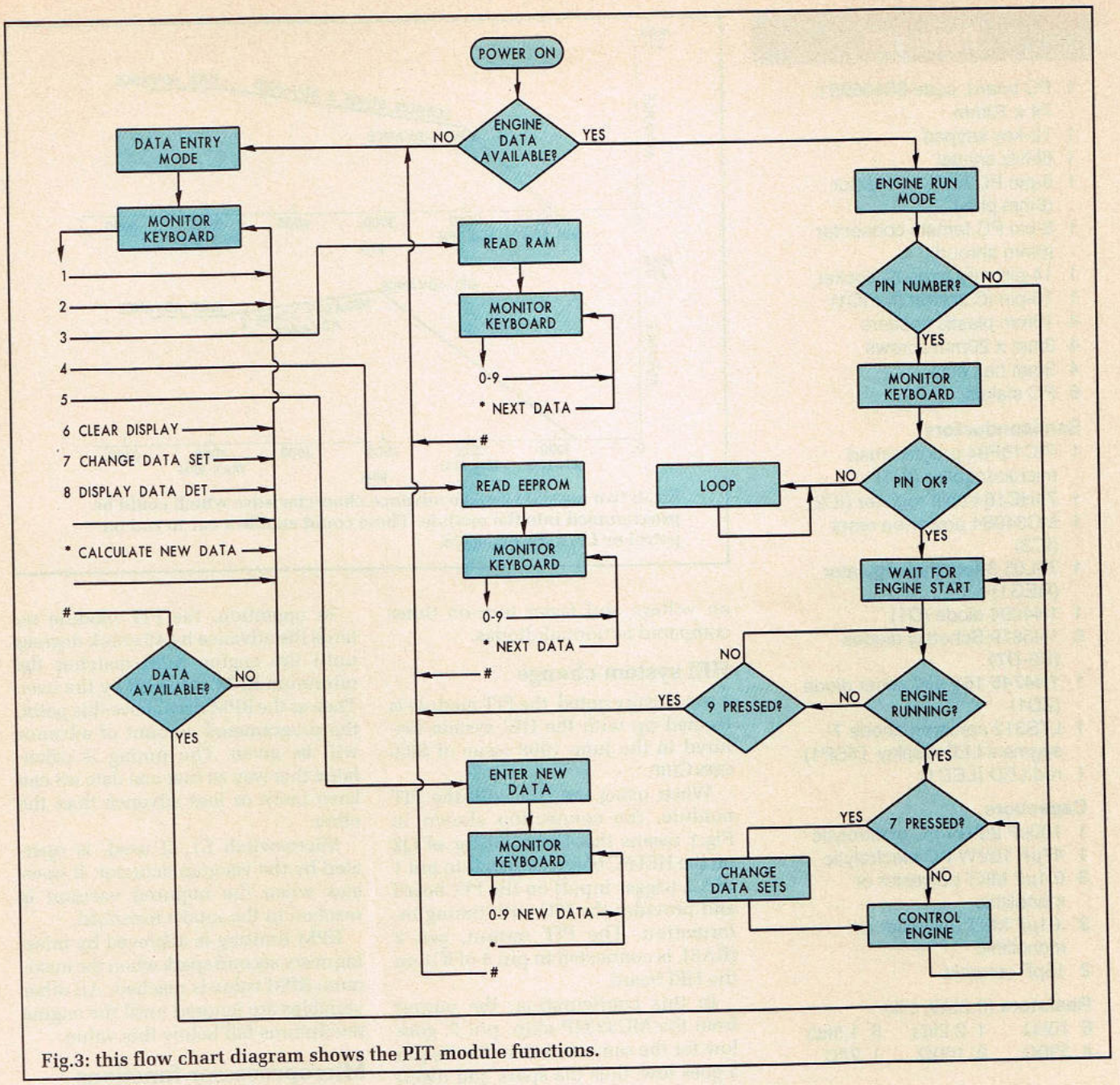


Fig.3: this flow chart diagram shows the PIT module functions.

activated by the vacuum actuator; ie, the standard diaphragm unit fitted to older distributors.

When the manifold vacuum is high, S1 is held open and RA4 is pulled high via resistor R8. Conversely, when the manifold vacuum is low, as when the accelerator is wide open, S1 is closed and RA4 is pulled low and this causes the PIC to retard the ignition timing.

The 7-segment LED display is driven from IC2, a 74HC164 serial to parallel shift register. This receives serial data from pin 17 (RA0) of the PIC and it is clocked from pin 18 (RA1). It's parallel data output drives the 7-segment display to indicate such things as errors, programmable system variables and which set of data will be used.

IC3 is an MC34064 undervoltage sensing circuit and it is used to ensure that the PIC resets reliably each time the ignition is turned on.

An 8MHz crystal, in conjunction with C6, C7 and R4, sets the clock speed for the PIC, while LED1 is driven from pin 13 (RB7) to provide trigger pulse status. This LED will be on when RA2 (pin 1) is low and off when RA2 is high.

The power supply uses a series diode (D1) for reverse polarity protection, a zener diode (ZD1) to clip any large voltage spikes and a 5V 3-terminal regulator (REG1). The latter supplies the 5V rail for the ICs and to the MC3334P on the HEI PC board.

There can be quite a lot of interference coming from the engine bay via the wires connecting to the input and output pins on the PIC. Diodes D2-D7 together with resistors R17 to R19 and capacitors C8-C10 help shunt this interference back to the power supply. The IN5819 diodes specified are Schottky types and have a lower turn-

Parts List

1 PC board, code 05406991, 74 x 70mm
1 12-key keypad
1 8MHz crystal
1 8-pin PC male connector (6mm pins)
1 8-pin PC female connector (6mm shroud)
1 14-pin wire wrap IC socket
1 18-pin IC socket (for IC1)
4 10mm plastic spacers
4 3mm x 20mm screws
4 3mm hex nuts
6 PC stakes

Semiconductors

1 PIC16F84 programmed microcontroller (IC1)
1 74HC164 shift register (IC2)
1 MC34064 power-on reset (IC3)
1 78L05 3-terminal regulator (REG1)
1 1N4004 diode (D1)
6 1N5819 Schottky diodes (D2-D7)
1 1N4745 16V 1W zener diode (ZD1)
1 LTS312 common anode 7-segment LED display DISP1)
1 red LED (LED1)

Capacitors

1 100µF 25VW PC electrolytic
1 47µF 16VW PC electrolytic
3 0.1µF MKT polyester or monolithic
3 .01µF MKT polyester or monolithic
2 18pF ceramic

Resistors (0.25W, 1%)

6 10kΩ	1 2.2kΩ	8 1.5kΩ
4 330Ω	3 100Ω	1 22Ω

Note: the programmed 16F84 microcontroller can be purchased for $27, including postage, from Mr A. Nixon, 8 Westminster Court, Somerville, VIC 3912.

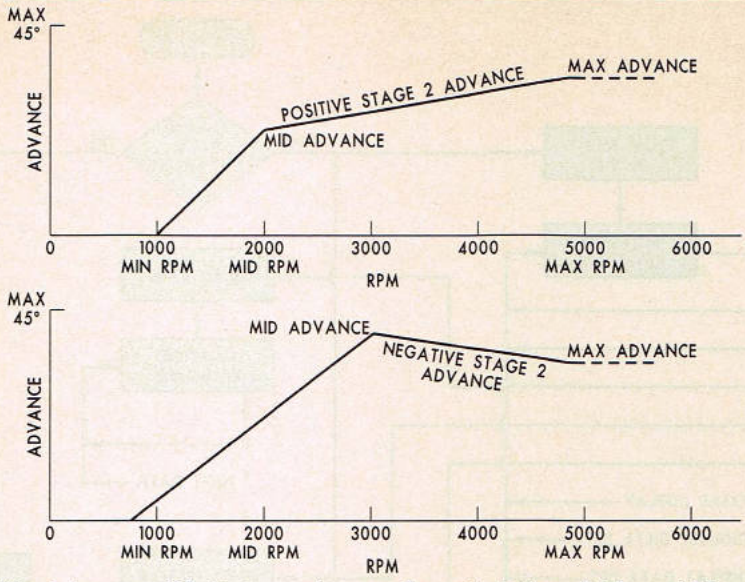


Fig.4: two possible 2-stage advance characteristics which could be programmed into the module. These could enable a car to run on petrol or LPG, for example.

on voltage and faster turn-on times compared to normal diodes.

HEI system change

As already noted, the PIT module is teamed up with the HEI system featured in the June 1998 issue of SILICON CHIP.

When using the HEI with the PIT module, the connection shown in Fig.1 means that the collector of Q2 on the HEI PC board connects to pin 1 (RA2, trigger input) on the PIT board and provides the PIC with timing information. The PIT output, pin 2 (RA3), is connected to pin 5 of IC1 on the HEI board.

In this configuration, the output from the MC3334P chip, pin 7, goes low for the same duration that its pin 5 goes low, thus the spark and dwell timing are both derived from the PIT module and not the HEI board. A 5V supply is taken from the PIT module to power the MC3334P chip, to make it compatible with the PIC.

In operation, the PIT module retards the advance by 45 crank degrees until the engine RPM matches the minimum RPM value set by the user. Then as the RPM rises above this point, the programmed amount of advance will be given. The timing is calculated this way so that one data set can have more or less advance than the other.

Microswitch S1, if used, is operated by the vacuum actuator. It operates when the required vacuum is reached in the intake manifold.

RPM limiting is achieved by missing every second spark when the maximum RPM value is reached. All other variables are ignored until the engine revolutions fall below this value.

Microprocessor functions

Instead of using look-up tables for engine data, the program pre-calculates a set of variables based on the data entered by the user and then stores these into the PIC's internal

Table 1: Resistor Colour Codes

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
☐	6	10kΩ	brown black orange brown	brown black black red brown
☐	1	2.2kΩ	red red red brown	red red black brown brown
☐	8	1.5Ω	brown green red brown	brown green black brown brown
☐	4	330Ω	orange orange brown brown	orange orange black black brown
☐	3	100Ω	brown black brown brown	brown black black black brown
☐	1	22Ω	red red black brown	red red black gold brown

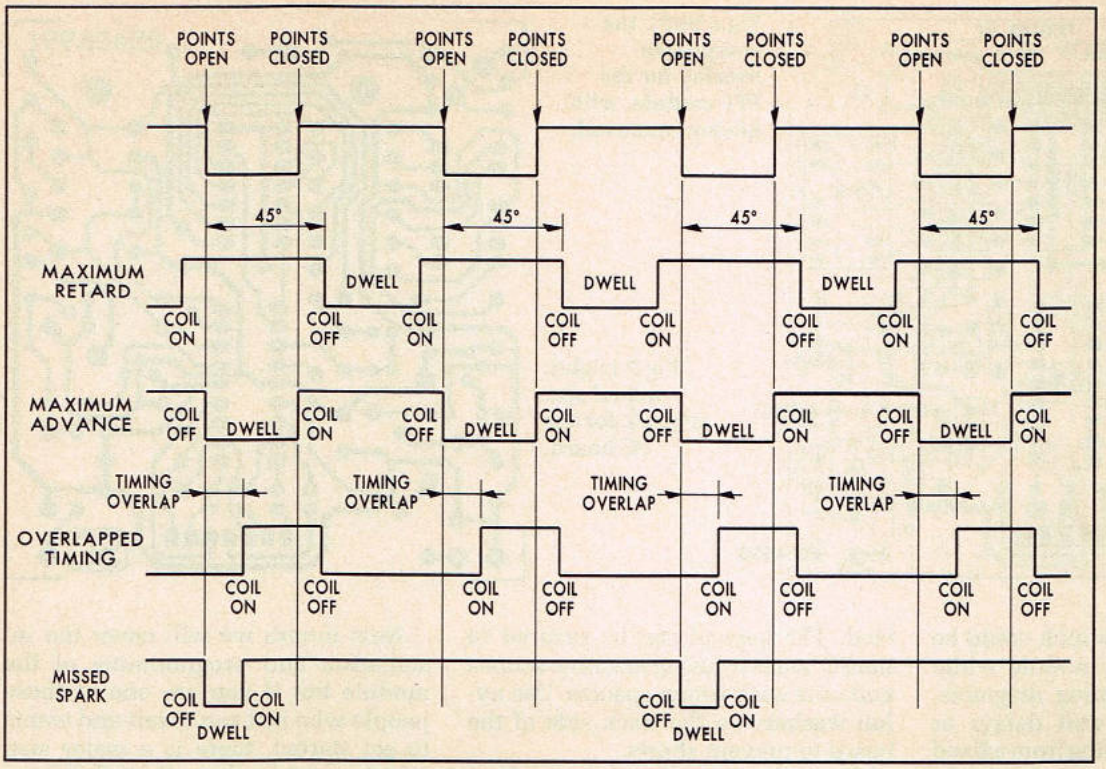


Fig.5: this shows some timing diagrams for a V8, illustrating how the unit delays or retards the ignition timing from a fixed setting.

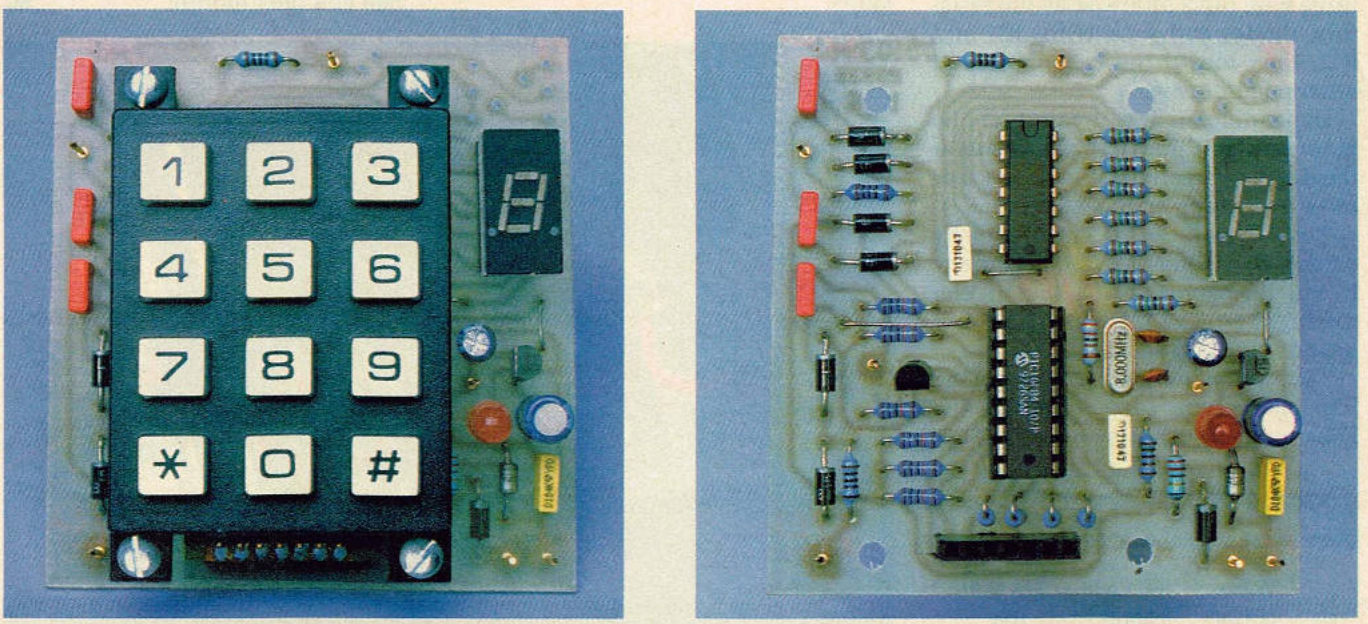
EEPROM. The PIC uses these variables to generate the appropriate advance settings and therefore does not have to do time-consuming calculations while the motor is running.

The PIC's ignition functions include monitoring the engine RPM, advance timing, dwell pulse width, maximum RPM detect, vacuum pulse width and keeping a constant 45° retard below the minimum RPM point. As these functions are dynamic and are changing all the time, the PIC has to continuously update new data at a very fast rate.

It is interesting to note that to keep track of all these functions, the PIC uses about 50 words of code and takes roughly 40µs to update everything. Most of the program memory is taken up by the user interface, while the rest is used for data calculations, the serial display and keypad. It was quite a task to fit all of these functions into a chip that has a mere 1K of ROM.

When the PIT module is turned on via the ignition, the PIC will turn the ignition coil on, via the HEI system. If the motor is not started after about six seconds, the coil will be switched off but the PIC will still wait for the motor to be started. This eliminates the possibility of any damage to the coil caused by leaving the ignition on without the motor running. When the motor is cranked over, the PIC will not allow a spark to occur until it has received four trigger pulses. This is to allow the software to stabilise its timing functions.

Fig.3 shows a flow diagram of the functions of the PIC microcontroller. Fig.4 shows two possible 2-stage ad-



The assembled PC board with and without the keypad. The keypad slots into the connector bottom centre of the right-hand photograph. Note the IC socket used for the PIC processor – while they make life easy for constructors, in the harsh automotive environment they sometimes give problems. Whether you use a socket or not is up to you.

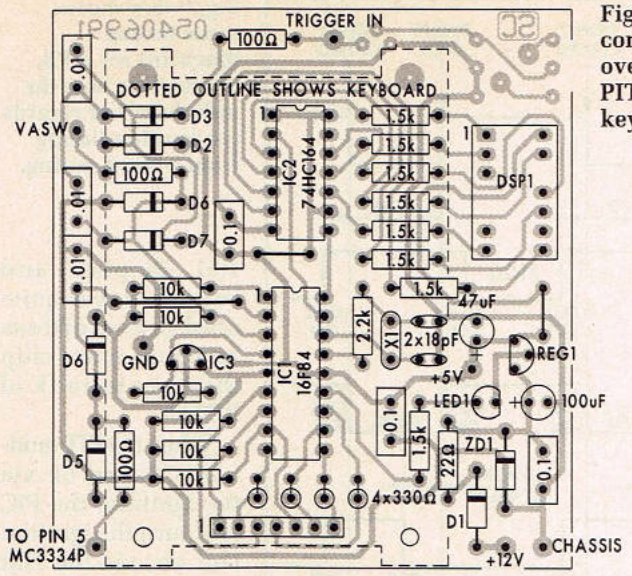


Fig.6 (left): the component overlay for the PIT module, with keypad removed.

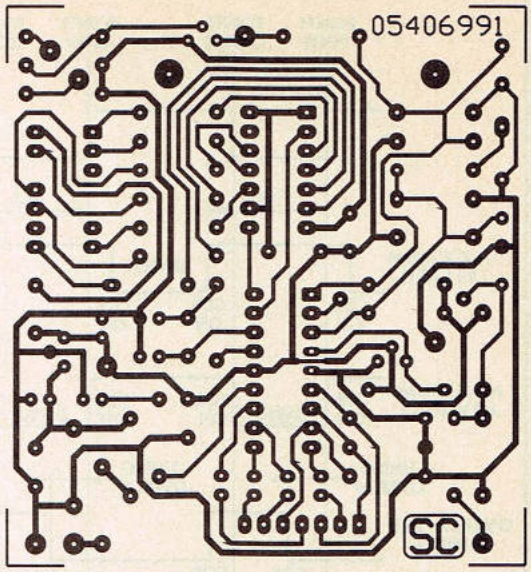


Fig.7 (right): actual size artwork for the PC board.

vance characteristics which could be programmed into the module while Fig.5 shows some timing diagrams, illustrating how the unit delays or retards the ignition timing from a fixed setting.

Construction

The PIT module is easy to build and all the parts except for the microswitch S1 are installed on the PC board.

The component layout is shown in Fig.6.

As always, check the PC board for open circuit or bridged tracks before you begin assembly. This done, fit the three wire links followed by the resistors, diodes and sockets for IC1 and IC2, then install the capacitors and other components.

Depending on how the unit will be mounted, you may choose to solder the display directly to the PC board or raise it by using an IC socket.

The keypad can be connected by using a short length of ribbon cable or it can be connected so that it can easily be removed, by using a 7-pin header plug and socket.

Take care with the placement of the ICs, electrolytic capacitors and the LED, as these components are polarized. The keypad can be secured to the PC board by using machine screws and nuts with 10mm spacers. Use nylon washers on the track side of the board to prevent shorts.

Once the assembly is complete, check all your soldered joints carefully and check the polarity of D1. When you are satisfied that all is OK, insert both chips and connect 12V to the PC board terminals on the lower right side of the board. The ground connection is on the outside.

When you have done this the centre segment of the display should light. If this test fails, you will need to go over the PC board again and check for faults.

Next month we will cover the installation and programming of the module but if you are one of those people who just can't wait and wants to get started, there is a major step which must be done first: that is to install and check out the HEI system on your car.

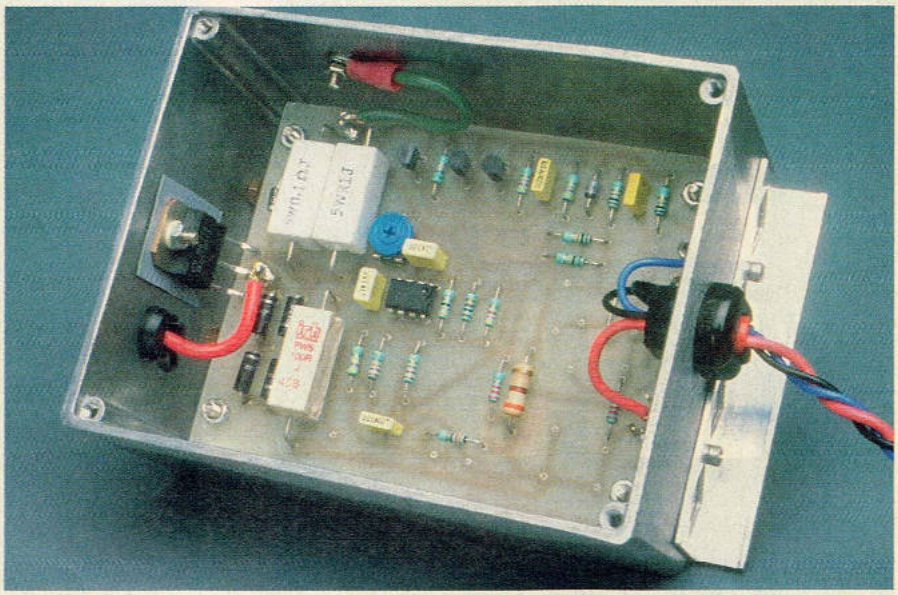
Get it all going properly, according to the procedure set out in the June 1998 issue. Naturally, this installation will have no connections to the PIT module.

When everything has been running with the HEI installed for several weeks, you are ready to proceed to the PIT installation and programming.

See you next month. **SC**

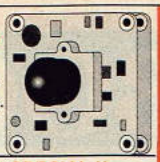
Table 2: Capacitor Codes

	Value	IEC Code	EIA code
☐	0.1µF	100nF	104
☐	.01µF	10nF	103
☐	18pF	18p	180



Again reproduced from the June 1998 SILICON CHIP, this photo shows an internal view of the High Energy Ignition System. Your first step in building the Programmable Timing Module is to get this ignition system working properly.

COLOUR CCD 42X42mm CAMERAS
with 1 of these lenses 3.6mm-92 deg./4.3mm -78 deg. 5.5mm60 deg. Special introductory Price of just $189



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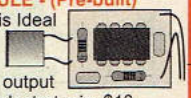

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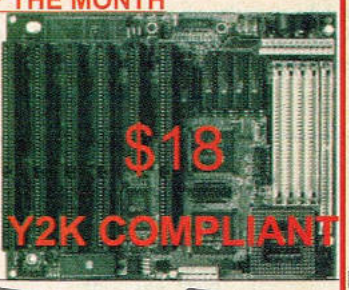

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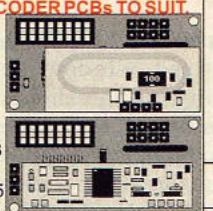

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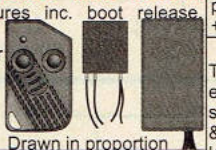

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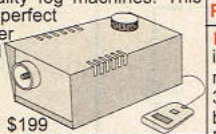

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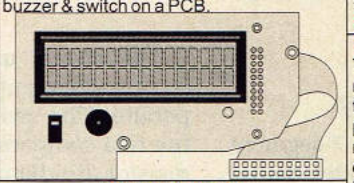

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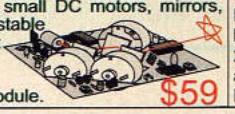

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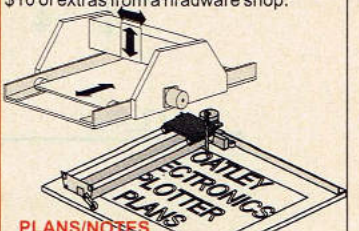

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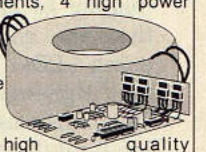

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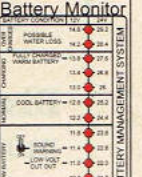

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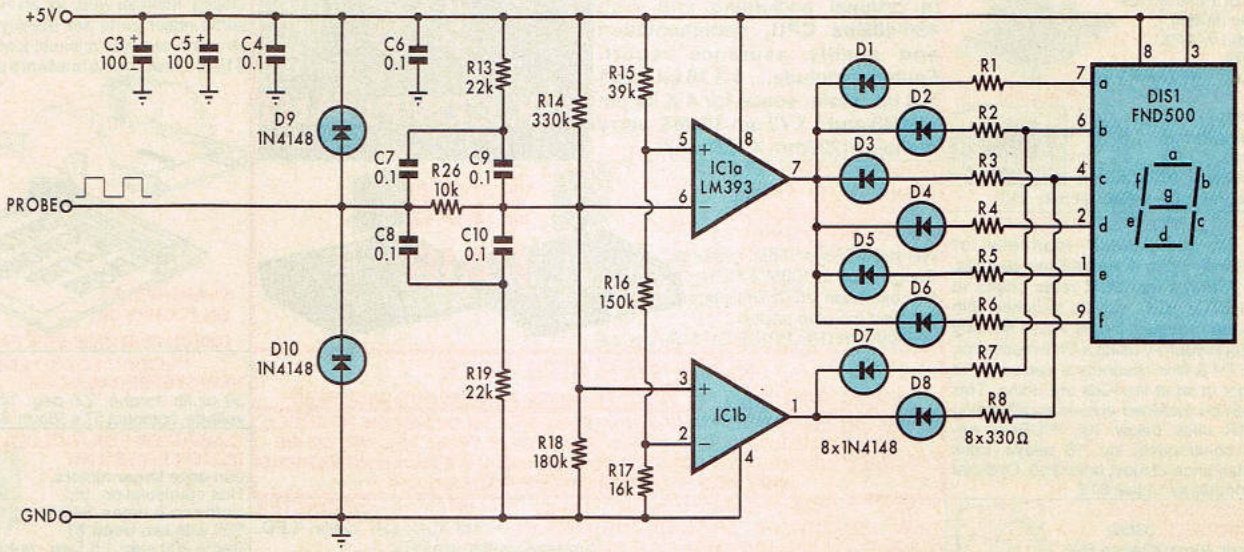
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Logic probe with 7-segment display

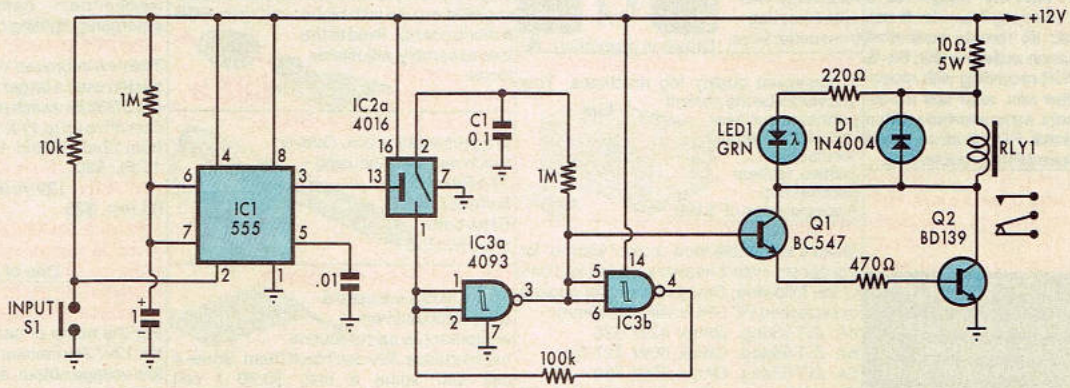
This logic probe uses a 7-segment display to show logic states rather than the conventional approach of using LEDs. The display shows "1" for a high logic state and "0" for a low. This can be useful when troubleshooting 8-bit decoding circuits.

The circuit uses an LM393 dual comparator set up as a "window" comparator. The switching thresholds of the two comparators are set by the 3-resistor divider connected to pins 5 & 2 while the input signal is connected via a 10kΩ resistor to pins 6 & 3. D9 & D10 provide input protection while capacitors C7-C10 provide filtering to prevent false triggering.

When the input signal is high, IC1a's output goes low to turn on segments a, b, c, d, e & f, via diodes D1-D6. If the input signal is low, IC1b's output goes low to turn on segments b & c via diodes D7 & D8.

Note that the circuit is only suitable for CMOS logic operating at 5V.

T. Jackson,
Dural, NSW. ($35)

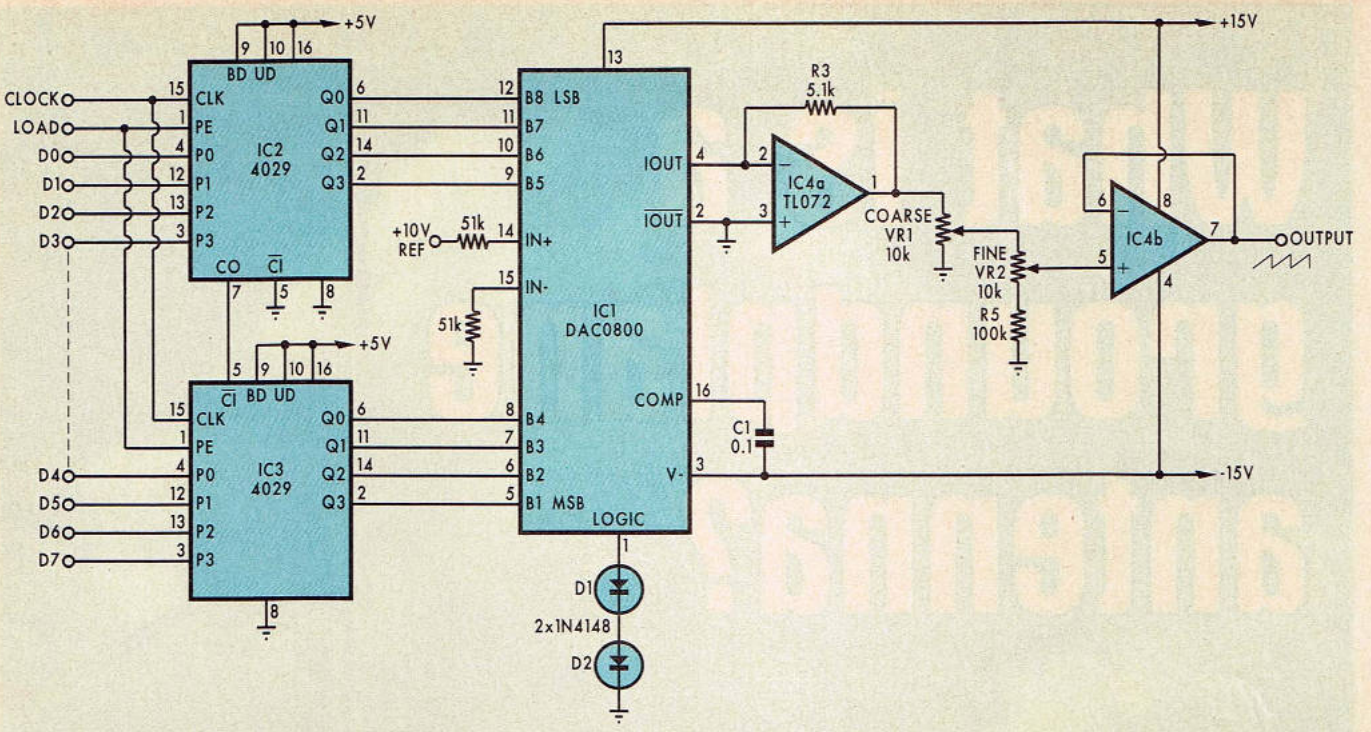


Bistable motor switch

This circuit was developed to switch a motor on and off in a production application, using a cord-operated switch. The cord switch momentarily closes a pair of contacts each time it is pulled.

The 555 timer operates as a monostable to eliminate any effect of contact bounce and has a one-second pulse time. It closes the analog switch (IC2a) in the 4016 to toggle an RS flipflop comprising IC3a & IC3b. Depending on whether the output of IC3a is high or low, Q1 is turned on to operate the relay and apply power to the motor.

P. Carter,
Berwick, Vic. ($30)



PC-controlled function generator

A number of older but nevertheless excellent spectrum analysers are still widely in use. Often these have been purchased secondhand for a fraction of the price of a new instrument.

However, many of these older instruments lack the facility of a computer interface and this limits their flexibility compared to more modern equipment.

The HP855x series of spectrum analysers are probably typical of the older spectrum analysers referred to above. They lack a PC interface but they do provide a "scan" connector that allows external control of the frequency scan by means of an analog voltage. I designed this circuit to interface an HP8553/54B spectrum analyser, via its scan connector, to the parallel port of a PC.

The input to the circuit consists of an 8-bit data signal plus a "Clock" and a "Load" input. In free running mode, the Load input is held at logical zero (0V), in which case the data inputs D0-D7 are ignored. In this mode, counters IC2 and IC3 run through their normal counting sequence, resulting in a sawtooth output waveform. The frequency of this waveform is controlled by the Clock input.

With the Load input held at logical one (+5V), the digital inputs D0-D7 override the Clock input and the analog output voltage is controlled by the data inputs D0-D7.

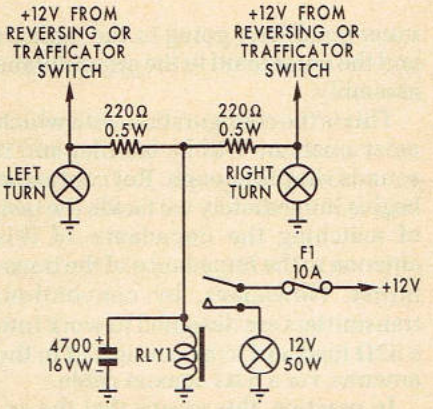
This circuit may be adapted for use as a general purpose function generator for a wide range of other possible applications. If faster clock or data rates are required, the circuit can be modified by replacing IC2 and IC3 with equivalent HCMOS devices. For higher resolution, IC1 could be replaced with a 10-bit or 12-bit DAC but this will also require the addition of another counter to supply the extra bits.

H. Nacinovich,
Gulgong, NSW. ($45)

Extra reversing light for older cars

This circuit allows an extra, brighter reversing light to be installed in older vehicles that have the rear turning indicators doubling as reversing lights.

With reverse gear selected and the standard reversing lights on, there is sufficient current through both the 220Ω resistors to operate the relay. When either turn indicator is operating, the respective 220Ω resistor limits the current through the relay coil, thus stopping the extra reversing light from coming on.

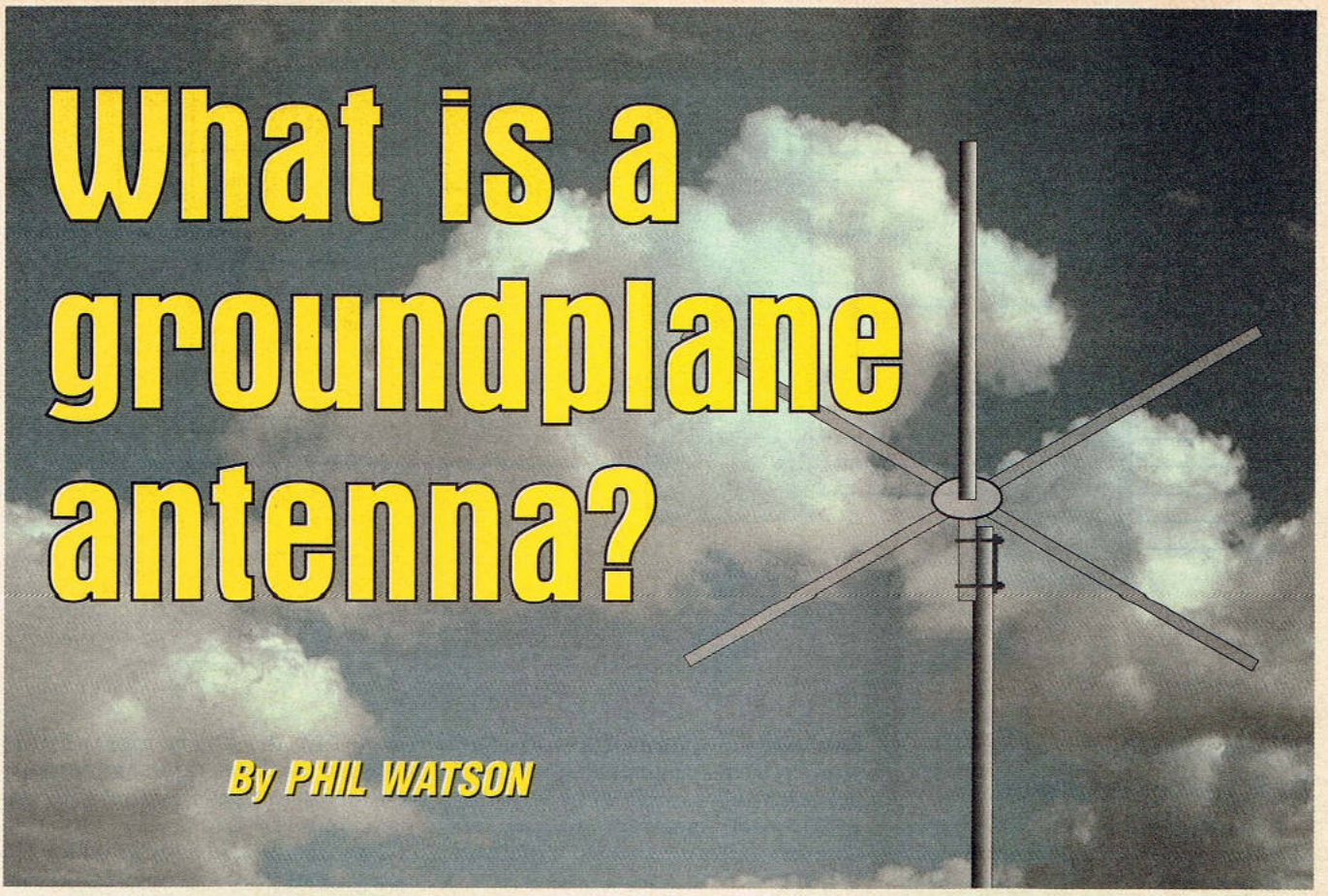


The 4700µF capacitor prevents the reversing light from coming on when the hazard lights are flashing, by making the relay slow to operate. It is only required if hazard warning lights are on the vehicle.

The wire size of the lead (which could be up to 5 metres long) from the fuse is critical, as a smaller gauge will reduce the brilliance of the extra reversing light.

C. Potter,
Kilsyth, Vic. ($25)

What is a groundplane antenna?



By PHIL WATSON

The term "groundplane antenna" often means different things to different people. There are two quite distinct antenna designs under this heading, a myriad of variations in between and lots of confusion as a result.

THE GROUNDPLANE antenna is probably the best known and most commonly used of all transmitting antennas, both in commercial and amateur roles. It is omnidirectional, simple to construct, uses low-cost materials and is equally suitable for base or mobile use.

In its basic form, it consists of a quarter-wavelength vertical radiator, mounted above four quarter-wavelength horizontal radials spaced 90° apart. These horizontal radials form the so-called "groundplane". This type of antenna is fed via coaxial cable, the inner conductor going to the radiator and the outer braid to the groundplane assembly.

This is the configuration with which most amateurs will be familiar and it sounds simple enough. But confusion begins immediately we tackle the task of matching the impedance of this antenna to the impedance of the transmitter. Nowadays, by convention, transmitters are designed to work into a 52Ω load and to be connected to the antenna via a 52Ω coaxial cable.

In practice, this means that the antenna should provide a 52Ω load. In reality, very few antennas provide such a load naturally and the groundplane is no exception. As a result, we have to modify the antenna, or the coupling to it, to present the transmitter with the correct load.

There are many well established ways of doing this but first, we need to know the natural impedance of the antenna, the mismatch that this creates, and the best way to correct it. So what is the natural impedance of the groundplane antenna? Put this question to most amateurs and nine times out of ten they will nominate 36Ω, a figure that's frequently quoted in the textbooks.

However, as more than one amateur has learned to his dismay, any attempt to develop a matching system based on this figure is doomed to failure. So is this a case where theory and practice don't agree? This is where things become confusing.

Groundplane development

In order to better understand the problem, let's first take a look at the

groundplane's history and clarify some of the published data.

The groundplane antenna evolved from the basic half-wave, centre-fed antenna; ie, a half-wavelength long radiator, broken at the centre to form a feed point. A half-wave centre-fed antenna has a natural radiation resistance of 72Ω, may be polarised horizontally or vertically, and is a very efficient antenna in its own right.

This type of antenna is most popular in the horizontal mode, particularly at the lower frequencies. It isn't used as much in the vertical mode because it would be impractically long at low frequencies, while the centre-feed requirement is an awkward arrangement in some applications.

The original groundplane antenna was designed to overcome these limitations. The radiator was reduced to a quarter-wave vertical element and this was mounted above a large conducting surface. In theory, the quarter-wave element is reflected by the conducting surface, thus providing the other half of the antenna which would thus be equivalent to a half-wave centre-fed system.

Theory also suggests that the reflecting surface should be infinitely large and have zero resistance. In practice, the Earth itself serves as the reflector and although it isn't perfect, it can be made very effective. Various tricks are often employed to enhance its performance, such as selecting a moist area of ground area and burying wires in the ground, radiating outwards from the vertical element. The theoretical radiation resistance of this type of antenna is 36Ω (ie, half 72Ω) but, in practice, this varies according to the efficiency of the groundplane.

Typical examples are the antennas used by radio stations in the broadcast band. A single mast acts as the radiator and, in its simplest form, is a quarter wavelength long. However, the length may vary, with some installations embracing the five-eighth wavelength concept or some other means to control the radiation angle. Often, the mast is located above moist or swampy ground, into which many radials are buried.

OK, so that's the background to what might be called the "original" or "earth" groundplane; names deliberately chosen to avoid confusion as we progress. It is popular with many amateurs, particularly for the higher HF bands – up to 30MHz – where the physical size of the radiator is more manageable.

However, it does have a disadvantage. Although fine for use out in the country, in the traditional 40-acre paddock with few nearby obstructions, it is less attractive in suburban backyards which are often surrounded by buildings on all sides. And as we go higher in frequency and the radiator becomes shorter, these obstructions become more and more detrimental.

The elevated groundplane

It's here that we come to another version of the groundplane antenna. Known as the "elevated groundplane", this is the version that's most familiar to amateurs working at VHF. Its development is usually credited to Dr George H. Brown and J. Epstein of RCA and took place around 1938, when interest in frequencies above 30MHz was increasing rapidly.

As mentioned earlier, it consists of a quarter-wave vertical radiator and four quarter-wave horizontal radials, emanating from the base of the radiator. The radials form an artificial groundplane which is no longer earth-bound, allowing the complete antenna system to be mounted high above surrounding obstacles.

And so the scene was set for confusion, with two somewhat different antenna configurations using the same name. Granted, one evolved from the other and for the most part, their behaviour is similar, even when it comes to the angle of radiation.

But one characteristic of the two antennas is significantly different – the feedpoint impedance. So what is the feedpoint impedance of an elevated groundplane antenna? This is a figure that has been difficult to accurately pin down. Indeed, one might take the cynical view and say that it depended on the last reference consulted.

But at least there was agreement on one point; the elevated groundplane has a lower impedance than the original groundplane and this was recognised by its creators back in 1938. They measured two values: 25Ω for one version and 21Ω for another.

Figures like this continued to be quoted for many years, with some writers having a bet each way by quoting 20-30Ω. What appears to be one of the first references to a realistic value is in the "RSGB Amateur Radio Handbook", Third Edition (page 365), where the value is quoted as being "less than 20Ω."

Later, in the "RSGB Radio Communication Handbook", Third Edition (page 12.81) is what appears to be the first mathematical explanation. In simplified form, this states that it is the theoretical value of a dipole feedpoint (73Ω) divided by four, or 18.25Ω. It adds that measured values are usually a little higher.

A later (6th) edition of this handbook expands on this theme. It quotes the dipole feedpoint impedance as the more usual 72Ω, thus making the calculated value 18Ω, and provides a more detailed explanation as to why this value may vary somewhat in practice.

Any attempt to develop a matching system based on an impedance of 36 ohms for an elevated groundplane antenna is doomed to failure.

So that's the basic background to the elevated groundplane antenna and, in particular, its feedpoint impedance. And, if it appears that this point has been unduly laboured, it was for a very good reason – to put to rest the confusion over feedpoint impedance that's occurred over the years.

This confusion has arisen because many well-known publications and textbooks have failed to recognise and make clear this all-important distinction between the two antennas. And at least one textbook has positively stated that the (elevated) groundplane, clearly portrayed diagrammatically, has an impedance of 30-35Ω. Not only that, but it goes on to describe a match-

ing stub, based on this figure, which is supposed to match it to a 75Ω coaxial cable – this some 30 years after the inventors, Brown and Epstein, had suggested a value as low as 20Ω.

Practical considerations

But the situation is really quite clear. The original or "earth" groundplane has a theoretical feedpoint impedance of 36Ω and a value close to this figure can be achieved given a favourable situation and an elaborate setup. Otherwise, the value may vary considerably.

On the other hand, the elevated groundplane has a theoretical figure of 18Ω and this value or one very close to it can also be achieved in practice. Between 18Ω and 20Ω is a frequently quoted range but the writer's own experience suggests that calculations based on 18Ω work out to be extremely close.

Having said that, it is necessary to point out that there can be intermediate conditions between these two configurations. A typical example is the mobile version – a vertical quarter-wave radiator above a vehicle body as the groundplane. There are so many variables here that the impedance is anybody's guess. It satisfies neither the elevated version nor the earth version.

So how long is a piece of string? If in doubt there is only one way to find out; measure it and see. But that's another story.

Another variable factor is the distance between the elevated groundplane and the true earth, and/or other conducting surfaces. This should be at least 0.5 wavelengths, or greater if possible. The most likely effect of nearby conducting surfaces is to raise the impedance towards the 36Ω. Maintaining good separation is not a difficult requirement to satisfy at VHF but may call for more attention at HF. At 14MHz (20 metres), for example, the required clearance would be 10 metres.

Matching problems

For now, let's settle for the true elevated version and accept an impedance value of 18Ω. Unfortunately, this is not exactly a convenient figure when it comes to matching the 52Ω impedance of the transmitter and the associated coax cable. Indeed, it represents a mismatch of nearly three to one (2.88:1).

And that brings us to the practical side – how do we match the two? Broadly speaking, there are two possible approaches: (1) interpose a matching transformer (typically a quarter-wavelength of a suitable value coax), or (2) modify the antenna design itself so that it presents the desired impedance.

The author has tried both approaches, with near perfect results in both cases. However, this article will concentrate on the latter approach, mainly because it is physically simpler but also because it has some advantages in its own right.

By juggling the element diameters, we can continuously vary the feed impedance over a wide range. In short, we can design an antenna to have exactly the impedance we require.

In simple terms, the method is a variation of the folded dipole concept, except that it uses a folded monopole. This is in no sense an original concept. It has been known and used in both amateur and commercial circles for many years. However, it has never attracted much publicity.

As is well known, a folded dipole has an impedance that's four times that of a simple dipole – ie, 288Ω. This figure is usually rounded to 300Ω. The same applies to a folded monopole, which has a feedpoint impedance of 4 x 18Ω, or 72Ω. Admittedly, this is still not a perfect match to a 52Ω system but it is a good deal better than that of a simple monopole. In fact the error is now only 1.4:1.

To digress briefly, this approach was used extensively during the early days of VHF mobile radio systems, mainly for base antennas. The transmitters of the day were designed for a 75Ω load, using 75Ω cable. The basic folded monopole presented an impedance of 72Ω; as near perfect a match as one could wish for.

This approach to a 72Ω load requirement is suggested in the "RSGB Radio Communication Handbook", 3rd edition, p12.82 (Fig.12.123(d)) and further confirms the 18Ω basic value.

The 52Ω standard is not quite so easily accommodated but we have another trick up our sleeve. In its basic form, the folded radiator uses the same diameter conductors for both the active and passive elements. And in this form the spacing between the elements is not critical. But when we use different diameter conductors for the two elements, the picture changes.

The spacing now becomes a factor in determining the feed impedance and by also juggling the element diameters, we can continuously vary the feed impedance over a wide range. In short, we can design an antenna to have exactly the feed impedance we require.

A formula and a graph, which can be used to calculate the design of a folded dipole, have appeared in several publications, including the "ARRL Antenna Book", 14th Edition (p2-29) and this is equally applicable to the folded monopole concept.

The formula is as follows:

$$r = [1 + \log(2S/d1)/\log(2S/d2)]^2$$

where S = spacing between elements
d1 = driven element diameter
d2 = passive element diameter
r = impedance ratio

As can be seen, in this configuration the formula solves the impedance ratio for any nominated combination of element diameters and spacing. Unfortunately, this is not the most convenient way of going about things because, given the element diameters and the required impedance ratio, it is necessary to make a series of trial and error calculations to find the correct spacing.

In practice, we would prefer to directly calculate the element spacing to give the required ratio, after first nominating the element diameters we wish to use. These diameters will in

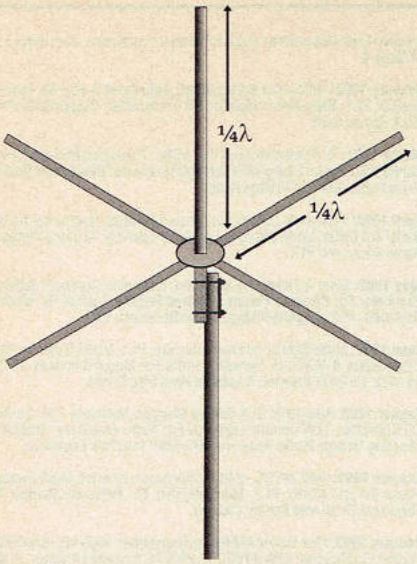


Fig.1: basic concept of an elevated groundplane antenna. It consists of a quarter-wave vertical radiator plus four quarter-wave horizontal radials, which form an artificial groundplane, emanating from its base.

turn depend on the material to hand or on what can be obtained. Unfortunately, transposing this equation so that we can directly calculate the spacing (S) is not straightforward.

This problem was solved by sticking to the trial and error approach but letting a spreadsheet do all the calculations. This method was used to produce a list of ratios from given element diameters, with the spacing increasing in 1mm steps. Although this approach might seem a little clumsy, it works very well and was used for the practical design described below.

Note that this calculation gives the space between the element centres. This means that, in some cases, the physical spacing between the two elements will be quite small when their diameters are taken into consideration. In fact, it may even be impossible to space them correctly, since the theoretical figure would require the two elements to overlap.

The answer here, of course, is to recalculate the ratios using elements with different diameters.

Putting all this theory into practice resulted in the following dimensions for an antenna designed for 146MHz and measuring 470mm. Using a 2.89 (ie. 52 ÷ 18) multiplication factor and taking advantage of available materials, a prototype was constructed using a 5/16-inch diameter driven element (made of brass tube), a 1/8-inch brass rod passive element, and a spacing of 28mm between the outside diameters.

And the result? Although the prototype was rather hurriedly constructed, it came up with an SWR ranging from 1.05:1 to 1.1:1 across the 2-metre band. So the theory and practice can be made to agree very closely. And had it been considered worthwhile, the spacing could have been juggled a fraction to come even closer to optimum.

And that brings us to the other advantages of this arrangement, hinted at earlier. First, the folded element is inherently broadband, so rather than suffering any trade-offs with this arrangement, we actually score a bonus.

Secondly, it is at earth potential in the DC sense, a valuable feature where there is a risk of a lightning discharge. In this case, the discharge is directed directly to earth, rather than via the equipment.

The actual construction details are best left to the individual and will vary with available materials and workshop facilities.

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October 1995: Geiger Counter; 3-Way Bass Reflex Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Fast Charger For Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

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December 1996: CD Recorders – The Next Add-On For Your PC; Active Filter Cleans Up CW Reception; Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Volume 9.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source (For Sound Level Meter Calibration); Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

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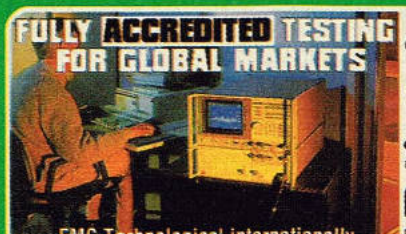

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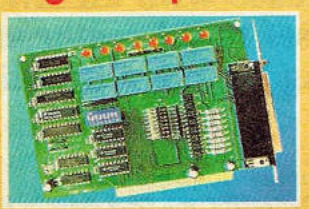

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Restoring a B15 mantle radio with some interesting faults

Just when you think that you've seen all the faults possible in vintage radios, another one suddenly pops up to shatter that sense of complacency. Such was the case with an AWA B15 1960s "plastic" mantle set that I restored recently. It had an interesting problem that lies dormant in many sets.

A friend recently asked me to do up a rather dilapidated AWA B15 5-valve mantle radio that he had acquired. Apparently, the set once belonged to a farmer and by the look of it, had spent many years in a shed gathering dust, grease, grime and the odd mouse dropping along the way.

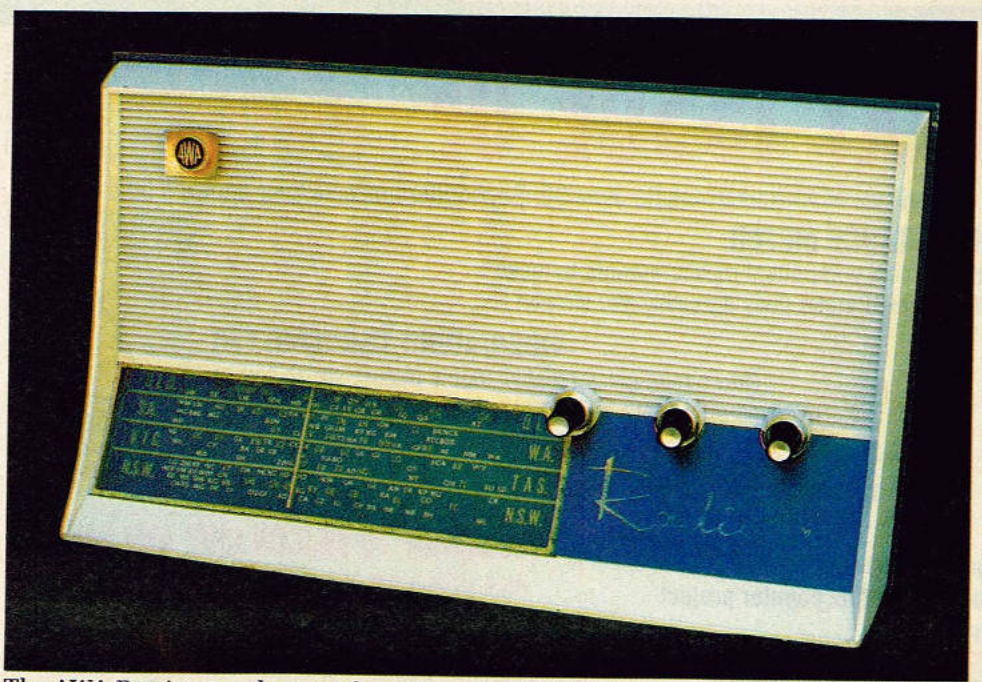
Obviously, the first step in the restoration process was to give the set a thorough clean-up. This meant removing the chassis and stripping all other parts from the set, so that the cabinet could be scrubbed in soapy water. After quite a bit of elbow grease, it scrubbed up quite well, as can be seen in the photos. Unfortunately though, the cabinet had several broken mounting posts. This prevented both the back and the loudspeaker from being properly secured.

As luck would have it, I was able to raid another scrap B15 for missing screws and a few other minor pieces. The back of the set is normally fastened by four metal-thread screws – two at the bottom into the chassis and two into threaded metal sleeves embedded in plastic posts. It was one of these posts that had broken.

To fix this problem, I fitted the metal sleeve into the base of the broken post and glued it in place using a small amount of 5-minute Araldite. I then made a larger sleeve out of paper and fitted it over the metal sleeve. Another batch of 5-minute Araldite was then made up and poured between the two sleeves. Some of this oozed out the bottom, making a wider area for the glue to grip.

Once this batch had set, another small amount of Araldite was mixed up and poured between the sleeves to build the post up further. It was a bit of a messy job but the end result was quite satisfactory. The owner wasn't after a meticulous restoration job – just a set that looked good and worked well. And of course, cost comes into it too.

The mice had been hungry and had devoured a section of the speaker cone. Despite this,



The AWA B15 is a 5-valve mantle set from the 1960s. The plastic cabinet caused a few restoration problems, as some of the internal mounting posts had broken.

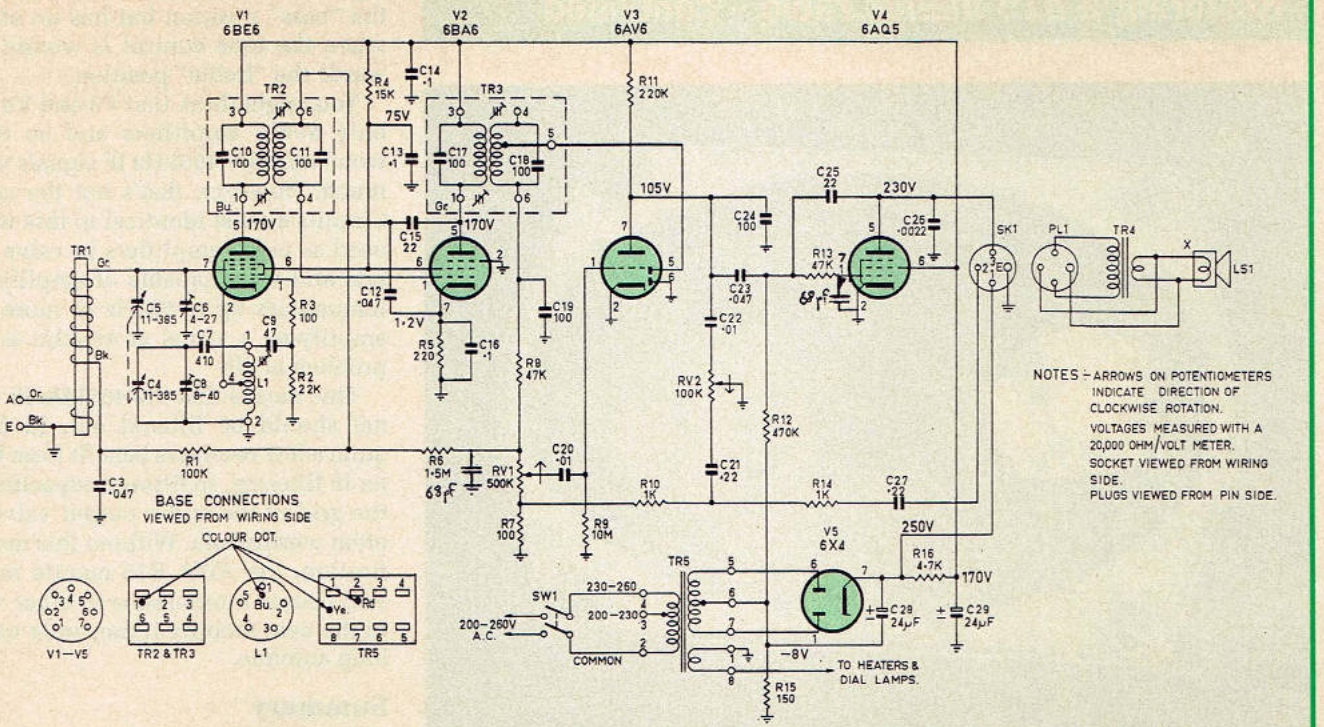


Fig.1: the circuit of the AWA B15 mantle radio set. The two hand-drawn 68pF capacitors were added to improve filtering of the 455kHz IF.

it still sounded OK after it had been cleaned, with no audible poling of the voice coil. It was repaired by "gluing" a piece of writing paper over the 25 x 25mm hole, using clear nail polish. Nail polish easily soaks into porous materials and is quite a good "glue" for this type of repair.

The repaired speaker can been seen in one of the photos. It may not be a joy to behold but it works well – particularly as price was an important part of the whole deal.

Unfortunately, two of the loudspeaker mounting posts had also been broken – a common problem with these sets. This meant that the loudspeaker had to be secured using just two retaining clips and mounting posts. The other two support posts were then attached using Tarzans Grip. There was just no other economical way of attaching the loudspeaker to the front of the cabinet.

Paper capacitors

UCC brand paper capacitors had been used throughout the set and these were all found to have significant leakage. All were replaced except for C14, C16, C21 and C27, as these four capacitors could have significant leakage without affecting the operation of the set. Once this work had been completed, the set "worked" but its performance was rather poor. Clearly, it needed more work to bring it up to scratch.

A close examination of the chassis soon revealed that someone in the past had replaced R11 (220kΩ) with a 100kΩ resistor. This resistor had altered the operating conditions for the 6AV6 (V3), so it was replaced with the correct value.

Next, I discovered that the HT voltages from the power supply were rather low. A replacement 6X4 rectifier valve soon livened things up by increasing the HT voltage, after which the set was beginning to show some promise.

Alignment

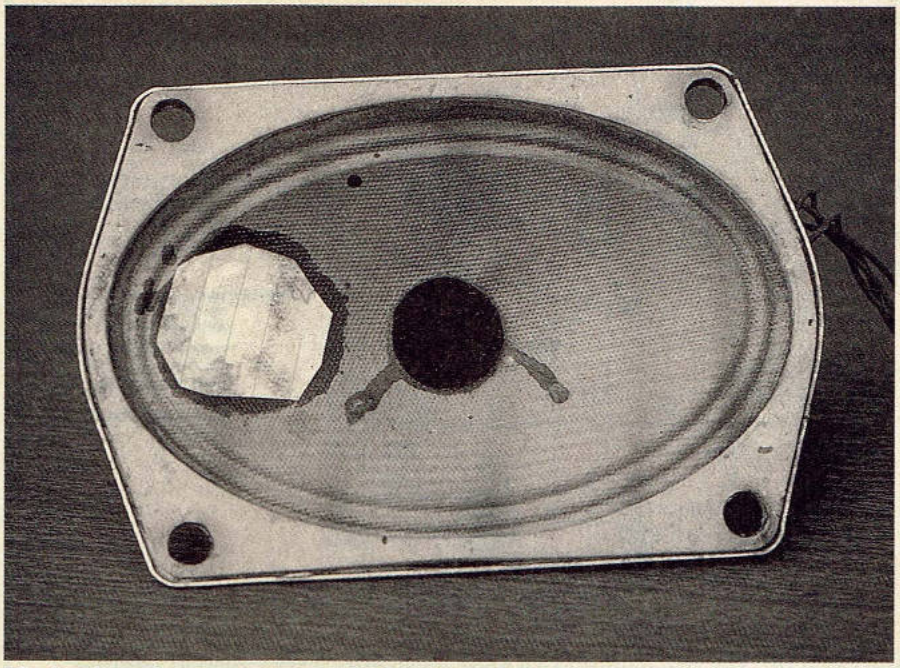
My next step was to carefully check the set's alignment. The IF (intermediate frequency) stages were found to be close enough for all practical purposes, although a tweak did give a bit of a lift in performance. The oscillator stage was a different story. It was about right at the low frequency end of the dial but was miles out at the top end. This meant that the oscillator trimmer had to be wound in, so that the stations appeared at the correct places on the dial.

In order to detect the peak output (and thus the correct alignment point), I attached a digital voltmeter across the AGC filter capacitor (C3 in this case). This allowed me to measure the AGC voltage developed when a reasonably strong input signal was applied to the set.

Having set up the voltmeter, the antenna coil was slid along the ferrite rod and adjusted for peak output with the set tuned to 621kHz. The antenna trimmer was then adjusted for peak output at around 1450kHz.

After all this effort, the performance was still not really all that marvellous. What else could be checked? First, I tried replacing the 6BE6 and 6BA6 RF & IF amplifier valves (V1 & V2) and found that this lifted the performance noticeably. I also found that the back bias across R15 was low, so a fresh 6AQ5 (V4) was tried. This noticeably increased the back bias, along with the audio output level.

The set was now better but still had a couple of problems. The first was an intermittent fault, the set working quite normally and then abruptly



The loudspeaker cone was patched up by "gluing" a piece of writing paper over the 25 x 25mm hole, using clear nail polish. It might look a bit rough but the speaker still works well.

changing volume. It appeared to be slightly sensitive to movement and eventually, after some judicious prodding around with the insulated handle of a small screwdriver, I discovered that C16 was the culprit. One tap dropped the volume; another brought it up again.

I should have known – another UCC capacitor. Not only did the UCC capacitors of that era go leaky, they also went intermittently open-circuit. Once this was replaced, the volume remained constant but the set still wasn't right – it tended to oscillate at the low frequency end of the dial and the sensitivity didn't seem to be what it should be.

I was puzzled about this, as everything in the set appeared to be correct. However, I then remembered that I'd had problems with several of these sets in the past, due to the 455kHz IF signal radiating back into the input (and also causing interference in other sets). I had previously cured this problem by connecting a 68pF ceramic or mica capacitor between pin 7 of the 6AQ5 and earth and adding a similar capacitor between the top of the volume control (RV1) and earth.

Once again, this approach did the trick – in fact, the instability at the low frequency end of the dial disappeared as soon as I connected a 68pF capacitor from pin 7 of the 6AQ5 to chassis. This also improved the sensitivity to the extent that a signal of just 1µV was useable. Readers should note, however, that the amount of improvement achieved by this minor modification may vary from set to set.

After that, it was simply a matter of reinstalling the chassis in the cabinet and giving the set a final soak test. The set ran very well and the owner was happy with the result.

Insufficient filtering

Why did the extra 68pF capacitors make such a difference? A glance at the circuit reveals that very little filtering of the 455kHz IF signal takes place after the detector. In fact, only C19 and C24 provide any degree of filtering and they don't do much. In effect, the unwanted 455kHz IF signal being fed to the audio amplifier was de-sensitising the whole set!

C24 (100pF) is relatively ineffective where it is and would have achieved a better result if it was connected between the grid of the 6AQ5 and chassis. C22 provides some filtering when the tone control (RV2) is in the "bass" position but has no effect when the tone control is wound towards the "treble" position.

You might think that V3 and V4 are only audio amplifiers and so they won't amplify 455kHz IF signals very much. However, that's not the case. Circuits almost identical to this were used as video amplifiers in valve TV sets and were capable of amplifying frequencies up to 5MHz or more, so amplifying a signal at 455kHz is no problem at all!

This means that the 455kHz IF signal should be filtered out. In fact, quite a few receivers benefit from better IF filtering, so fitting a capacitor to the grid of the audio output valve is often worthwhile. Without this modification, the AWA B15 mantle radio also causes interference to other sets in the near vicinity if they only use a loop antenna.

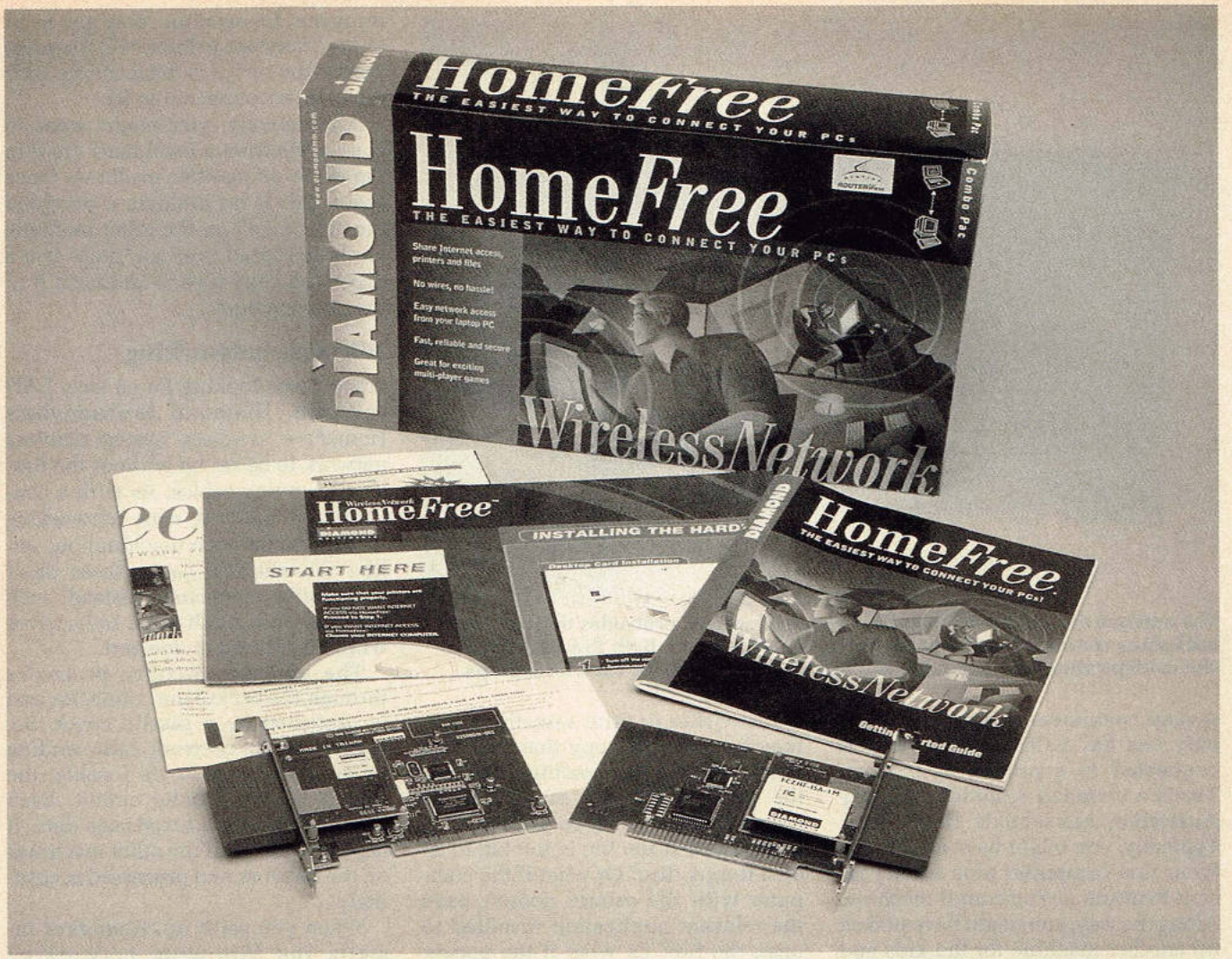
Summary

Some vintage radio enthusiasts would not consider a "plastic" set like this worthy of restoration. However, they are part of our radio heritage and so many find them quite collectable. That point aside, this particular set was a real mess when it arrived and it certainly had had a long, hard life. It needed a thorough clean-up, the replacement of most of its paper capacitors and four replacement valves (all low in emission) to get it up to scratch – and even then it required extra work to fix the remaining problems.

Fortunately, the coils and transformers in these sets are almost always OK, the exception being the speaker transformer which can occasionally have an open circuit primary winding.

Was it worth the effort? In terms of time and money, it was a doubtful proposition but for the old gent who owned it, the sentimental value made it worthwhile. It certainly looks a lot better than it did when it came in and it now performs very well – better than new, given the improved IF signal filtering. It is amazing how many of our manufacturers didn't quite get things right.

I have several such sets in my collection, all with the IF filter modification. They are not my favourite sets but I am quite happy to have them on display. **SC**



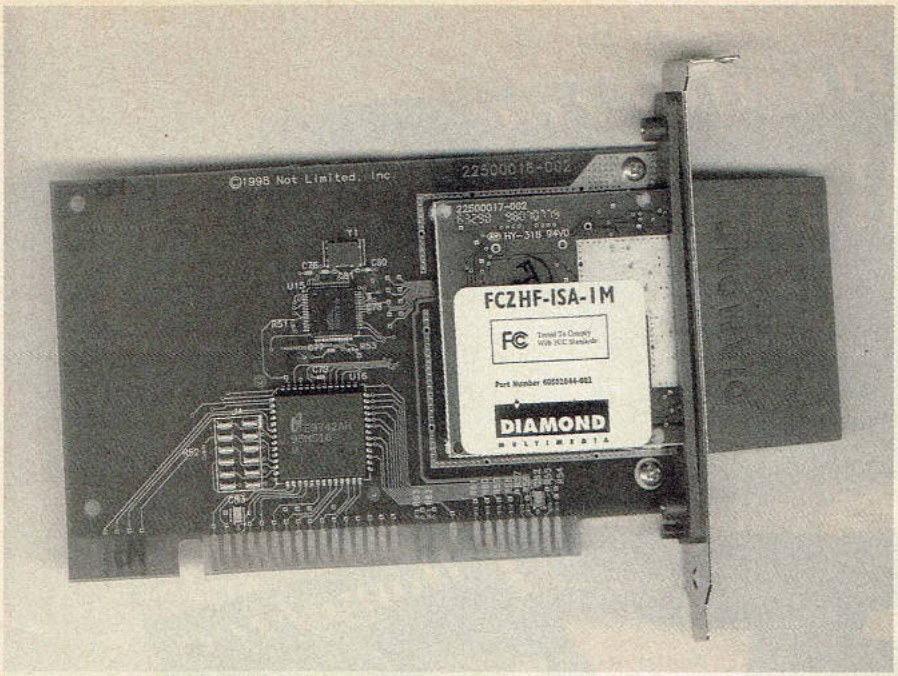
HomeFree: Diamond's wireless network

Looking for an easy way to install a computer network in your home? Diamond's new "HomeFree" networking system uses radio transmissions to broadcast data between computers on a local area network (LAN) and that means no messy cables to install.

By GREG SWAIN

IF YOU'VE EVER installed a small computer network, you'll know that the worst part of the job is the cabling. This particularly applies if the machines are in different rooms. Typically, that means drilling holes in the walls, installing wall sockets and running the cables from one room to another – usually via the roof space and down wall cavities.

But why would you want to network computers in your home? Well, consider a situation where you have



The antenna circuit of the Home*Free* networking card protrudes through the backplane connector and is protected by a plastic cover. Both ISA and PCI bus slot configurations are available and there's also a PCMCIA card for laptops.

several computers in your house but only one has a CD-ROM drive or is connected to a printer or modem. That's a common situation in many Australian households these days. Typically, you might have an old 486 (your first computer) plus a fairly recent Pentium or Pentium II machine. Along the way, you might have picked up another machine for the kids and then, of course, there's the laptop that you use for work.

Unless these machines are all networked together, it means that only one machine can access the printer, the Internet if you only have one modem, or some other resource. For example, if someone on another machine wishes to print something out, they have to first copy that file via a floppy disc to the machine that has the printer. The file must then be opened so that it can be printed.

But what if the file is too big to fit on a floppy disc? Or what if the computer with the printer doesn't have the relevant application installed to open the file? Or what if the person using the machine with the printer doesn't want to be interrupted?

A local area network or LAN solves these problems because it allows resources such as printers and disc drives (including ZIPs and CD-ROMs) to be easily shared. If someone on another machine wants to print something out, for example, they just print to the "network printer" via the print server (the server is the machine with the printer connected to it).

Alternatively, you might want to copy a file from a local hard drive to the drive on another machine. Once again, this is no problem – provided the "resource" on the other machine has been shared, you can "map" it as a drive and copy files to and from it in the usual manner.

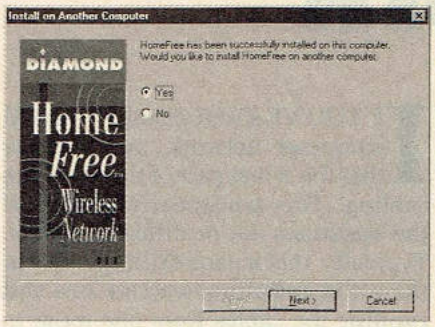
Wireless networking

For those looking for an easy LAN solution, Diamond Multimedia's Home*Free* "wireless" system allows a network to be set up without the hassle of running cables. As with a conventional LAN, it uses networking cards (one for each machine) but unlike conventional cards, these don't have cable connectors. Instead, each card carries a small radio transceiver which is located at one end.

The antenna circuitry protrudes through the backplane connector and is protected by a plastic cover. So, instead of the network card sending or receiving signals via a cable, the signals go via a radio circuit. Each time one machine broadcasts data, it is picked up by all the other machines on the network and processed accordingly.

When you set it up, Home*Free* installs the following networking protocols by default: TCP/IP, IPX, NetBIOS and NetBEUI. It also automatically shares any installed printers, installs a special "Transfer" folder on the C:\ drive of each computer and adds the names of other computers on the network to the Send To menu.

This makes it particularly easy to



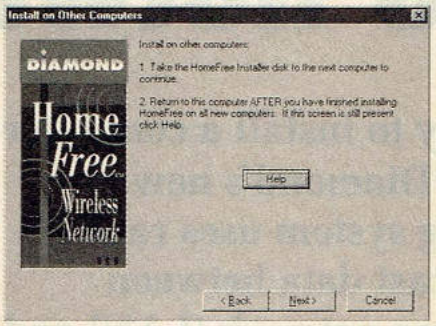

Install on Other Computers
DIAMOND
Home Free
Wireless Network
Install on other computers:
1. Take the HomeFree Installer disk to the next computer to continue.
2. Return to this computer AFTER you have finished installing HomeFree on all new computers. If this screen is still present click Help.
Help
< Back
Next >
Cancel

Fig.2: each time Home*Free* is installed, the software asks if you want to add another computer to the network. If the answer is "yes" you leave the existing machine(s) on the network running while the next PC is added. That way, the same ID code (CoNetID) is assigned to each PC, so that the machines on the network recognise each other. This CoNetID also locks out machines on other nearby Home*Free* networks.

HomeFree Assistant
Wireless Network
HomeFree
DIAMOND ASSISTANT
To add a new HomeFree computer, please complete the following steps:
1. Launch HomeFree Assistant on all existing HomeFree computers and select "Add a new HomeFree computer." You will see this screen.
2. Install HomeFree on all new computers.
3. Return to this computer AFTER you have finished Step 2. If this screen is still present, click HELP.
Cancel
Help

Fig.3: additional computers can be added to an existing network at any time by launching the Home*Free* Assistant utility that's installed on an existing machine.

copy files from one computer to another. All you have to do is right click the file you wish to copy and choose Send To Name, where Name is the name of the destination computer. The file will then be copied into the C:\Transfer folder of that computer.

Alternatively, you can check network connections, map drives and connect additional printers using Network Neighborhood, just as you do with a conventional wired network. And, of course, you can add printers using the Add Printer wizard.

In operation, Home*Free* can transmit data through walls and between floors in a typical home or office at distances up to about 45 metres. It operates in the 2.4GHz band and uses multiple encrypted channels. It also randomly switches frequencies and, according to Diamond, this makes it virtually impossible for another nearby Home*Free* installation to intercept and decode another network's transmissions.

Because it eliminates networking cables, Home*Free* allows any PCs on the network to be moved about within a room or even moved from one room to another. This is a particularly handy feature if you have a laptop computer, for example. You can take the computer home from work and it automatically becomes part of the network when you switch it on. And with Home*Free*, you will still be "connected" to the network if you elect to take your laptop poolside.

One drawback of Home*Free* is that the transmission speed is not as fast as for a wired network. Conventional wired LANs run at 10Mb/s or even at 100Mb/s whereas HomeFree is restricted to a more leisurely 1Mb/s. Even so, this shouldn't be a problem in most homes or even small offices, where modest file sizes are involved.

Internet access

As a bonus, Home*Free* also gives the user the option of setting up shared Internet access. This allows all users on the network to access the Internet via a single modem that's connected to one computer.

Basically, this option turns the Internet Computer into a "proxy server". When a "client" computer wants to access the Internet, it first connects to the proxy and the proxy then connects to the Internet.

If you want shared Internet access, you first install the Home*Free* software on the Internet computer (ie, the computer with the modem). During the setup, you will be asked to enter the User Name and Password from your ISP account, plus the domain name if your ISP requires one. Once it's all up and running, accessing the Internet is simply a matter of opening a web browser or email program from any computer on the network. If the Internet Computer (ie, the proxy) isn't already connected to the Internet, it will automatically dial into your ISP and connect.

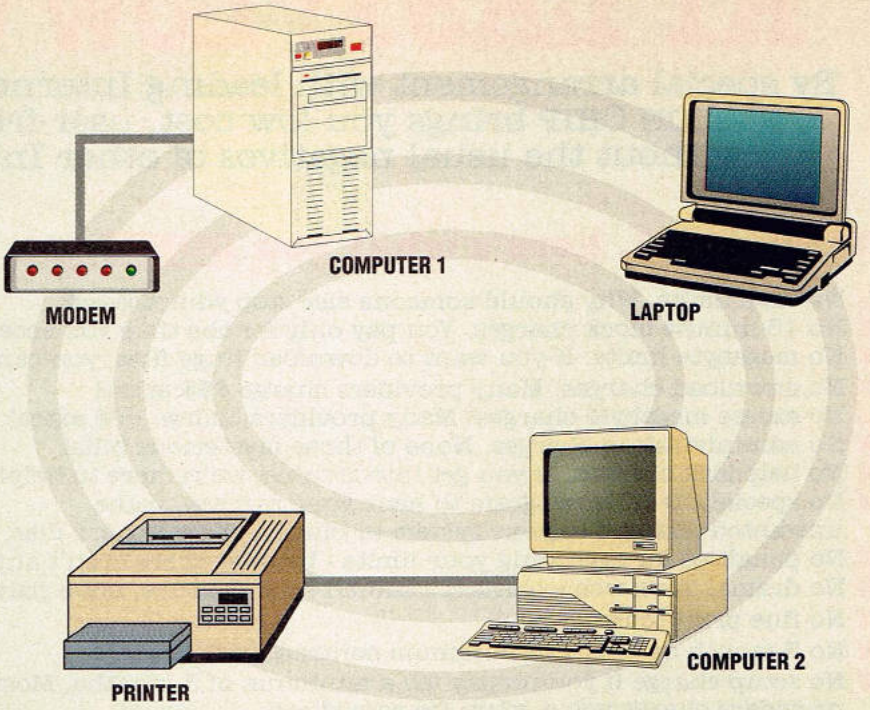
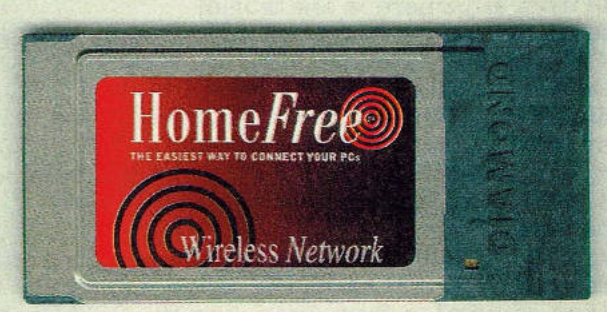


Fig.1: the Home*Free* networking concept. The computers are networked via radio transceivers integrated into the plug-in network cards, thus eliminating the need to run network cables. The software also allows all computers on the network to access the Internet via a single modem attached to one machine.



The PCMCIA card comes with the "Combo Pac" and plugs into a laptop computer. As with the PCI/ISA cards, it carries an on-board radio transceiver.

System requirements

At this stage, Home*Free* can only be used on PCs running either Windows 95 or Windows 98, with support expected for Windows NT later in the year. Each PC should be at least a 486 with a CD-ROM drive, 10MB of free hard disc space with one free ISA or PCI slot (or PC card slot for laptops).

Two different Home*Free* configurations are available: (1) the "Desktop Pac" containing one ISA card and one PCI card (for connecting two desktop computers); and (2) the "Combo Pac" containing one ISA card and one PC card (for connecting a desktop computer and a laptop computer). Additional computers can be added to the network by purchasing extra cards.

HomeFree is available from computer retailers and resellers across Australia. The Desktop Pac carries a recommended retail price of $499, while the Combo Pac costs $549. **SC**

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By special arrangement with leading Internet supplier Connect.Com, SILICON CHIP brings you low cost, user-friendly Internet access without the usual negatives of other Internet access plans.

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- ✘ No megabyte limits. If you want to download huge files, you can!
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Use this rate if you want to get onto the Internet for just a few hours per month and send/receive email.
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NO DOWNLOAD CHARGES

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et access with no catches

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Date of Application: _____

YOUR DETAILS

Name _____

Company Name (if applicable) _____ ACN: _____

Address _____

_____ Postcode _____

Postal address (if different to above) _____

_____ Postcode _____

Phone No. ( ) _____ Fax No. ( ) _____

Current email address (if applicable): _____ Signature: _____

PAYMENT DETAILS: CREDIT CARD ONLY!

❑ Bankcard ❑ VisaCard ❑ Mastercard **Card No:** ❑❑❑❑ ❑❑❑❑ ❑❑❑❑ ❑❑❑❑

Card expiry date ____/____ Cardholder Name (if different from above) _____

SERVICE TYPE One month minimum. If you prepay for three months you avoid paying the setup fee of $10.00

One Month ($10.00 SETUP FEE APPLIES)

❑ Low Vol: $10 + **$10 setup fee** (5hrs then $2.50/hr)
❑ Regular: $20 + **$10 setup fee** (10hrs then $2.20/hr)
❑ Power: $49.95 + **$10 setup fee** (25hrs then $1.95/hr)

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❑ Low Vol: $30 **no setup fee** (15hrs then $2.50/hr)
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Note: Charges are made on a calendar month basis. When do you wish to start: ❑ straight away ❑ beginning of next month

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First Choice:_____ Second Choice:_____ Third Choice:_____

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❑ Sydney (inc outer metro) ❑ Newcastle ❑ Wollongong ❑ Gosford, Windsor, Wiseman's Ferry
❑ Penrith, Mulgoa, Camden ❑ Campbelltown, Helensburgh ❑ Melbourne (inc outer metro) ❑ Geelong
❑ Cranbourne, Mornington ❑ Healesville, Emerald, Pakenham ❑ Gisborne, Romsey, Kilmore, Kinglake
❑ Lara, Balliang, Bacchus Marsh ❑ Brisbane (inc outer metro) ❑ Gold Coast ❑ Perth ❑ Adelaide
❑ Hobart ❑ Canberra

(Note: Some locations within these areas may be community or STD calls. Please check with your telephone service provider if inany doubt)

Initial charges (Credit card charged ONLY after password & setup information have been forwarded):

Monthly/3-monthly plan charge: $_____ Plus setup fee: $10.00 (if applicable) $ _____ = **Total: $** _____

Add-on for a commercial alarm gives up to 32 sensors, each individually monitored . . .

Make Your Alarm System More Versatile!

Do you have an alarm system fitted? Smart move! However, while many commercial burglar alarms have the advantage of good features and presentation for a reasonable price, they often don't have nearly enough inputs to cater for larger houses. Here's how you can extend a burglar alarm without spending a heap of dollars.

By MAX MAUGHAN

A few years ago I had a new two-storey house built. During construction, the wiring for all doors and windows was installed so that they could be monitored with reed switches and PIR detectors.

There are 32 devices to monitor: 22 windows, 6 doors and four PIR sensors. Every switch has its own pair of wires back to a central point.

Wiring 32 switches into four serial circuits to match the four available sectors was not a practical option.

There were six problems to solve and the following explains what these problems were and how they were solved.

(1). I wanted to use an unmodified commercial alarm system but its battery backup would also be required to power any add-on circuitry.

(2). A LED indicator panel was required to show which doors and windows were not shut before setting the alarm.

(3). A delayed entry door was required so that the alarm did not need to be disarmed and rearmed after every entry.

(4). I wanted an indoor siren to sound for 30 seconds before the external siren, so my neighbours didn't hear accidental alarms.

(5). I wanted to be able to arrive and leave by car, via one of two remote roller doors without tripping the PIR sensor in the garage.

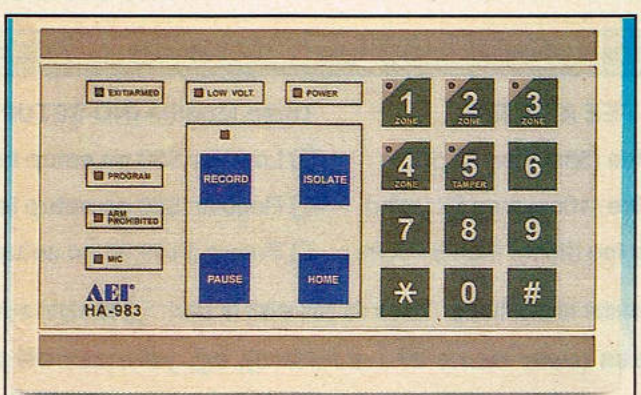
6. An exterior indicator was required to show when the alarm was set.

These requirements were met by using a decoder interface with an Altronics S-5490 four sector alarm which comes with an approved autodialer. This alarm may now be difficult to obtain but the decoder should be adaptable to the vast majority of alarms on the market.

The decoder interface is external to the alarm box. The circuitry uses high speed CMOS (74HC series chips) to ensure low power operation and this is run from the auxiliary power output (12VDC) of the alarm.

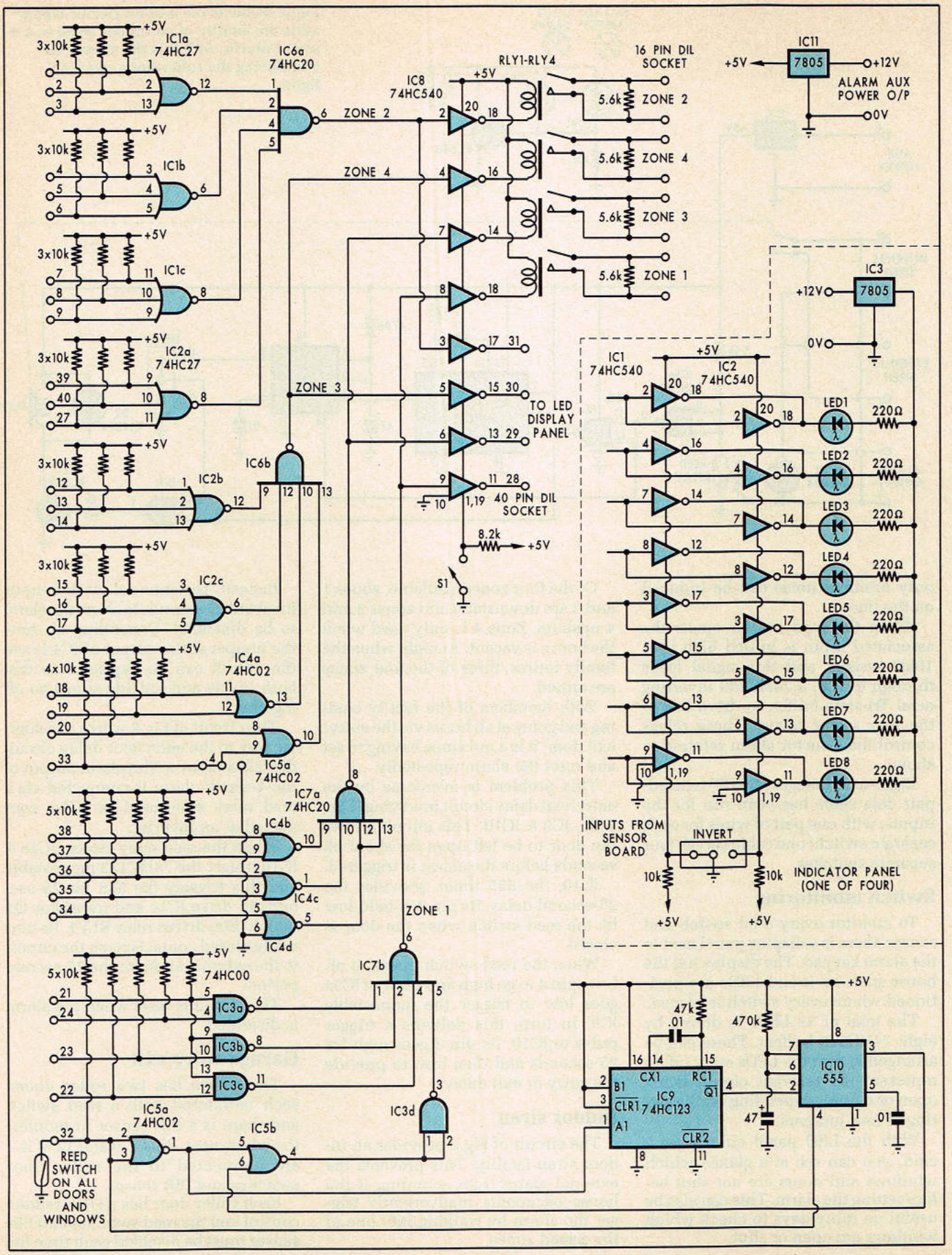
Each of the four input sectors of the alarm "sees" an end-of-line resistor and a pair of relay contacts. All input leads to the 4-sector alarm are only 50cm long which makes them effectively noise-free. Noise induced on long wiring lines is a major cause of false alarms.

Fig.1 shows the interface circuit. There are 32 inputs, provided by IC1, IC2, IC3, IC4 and IC7. Each input is pulled low by a reed switch (in fact, to 0V) so in the armed state



Not exactly the alarm used for the decoder interface, but similar: this is the new model Altronics S-5920 5-sector alarm. We believe that most commercial alarm systems will work satisfactorily with this project.

Fig.1 (right): this add-on circuit for a commercial 4-sector alarm provides for up to 32 points to be monitored with reed switches, PIR sensors or other devices.


IC1a 74HC27
IC6a 74HC20
IC8 74HC540
RLY1-RLY4
16 PIN DIL SOCKET
IC11
7805
+12V
ALARM AUX POWER O/P
0V
ZONE 2
ZONE 4
ZONE 3
ZONE 1
5.6k
TO LED DISPLAY PANEL
40 PIN DIL SOCKET
8.2k
S1
IC1b
IC1c
IC2a 74HC27
IC2b
IC2c
IC6b
IC4a 74HC02
IC5a 74HC02
IC7a 74HC20
IC4b
IC4c
IC4d
IC7b
IC3a
IC3b
IC3c
IC3d
74HC00
IC5a 74HC02
IC5b
REED SWITCH ON ALL DOORS AND WINDOWS
IC3
IC1 74HC540
IC2 74HC540
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
220Ω
INPUTS FROM SENSOR BOARD
INVERT
10k
INDICATOR PANEL (ONE OF FOUR)
IC9 74HC123
IC10 555
47k
.01
470k
47

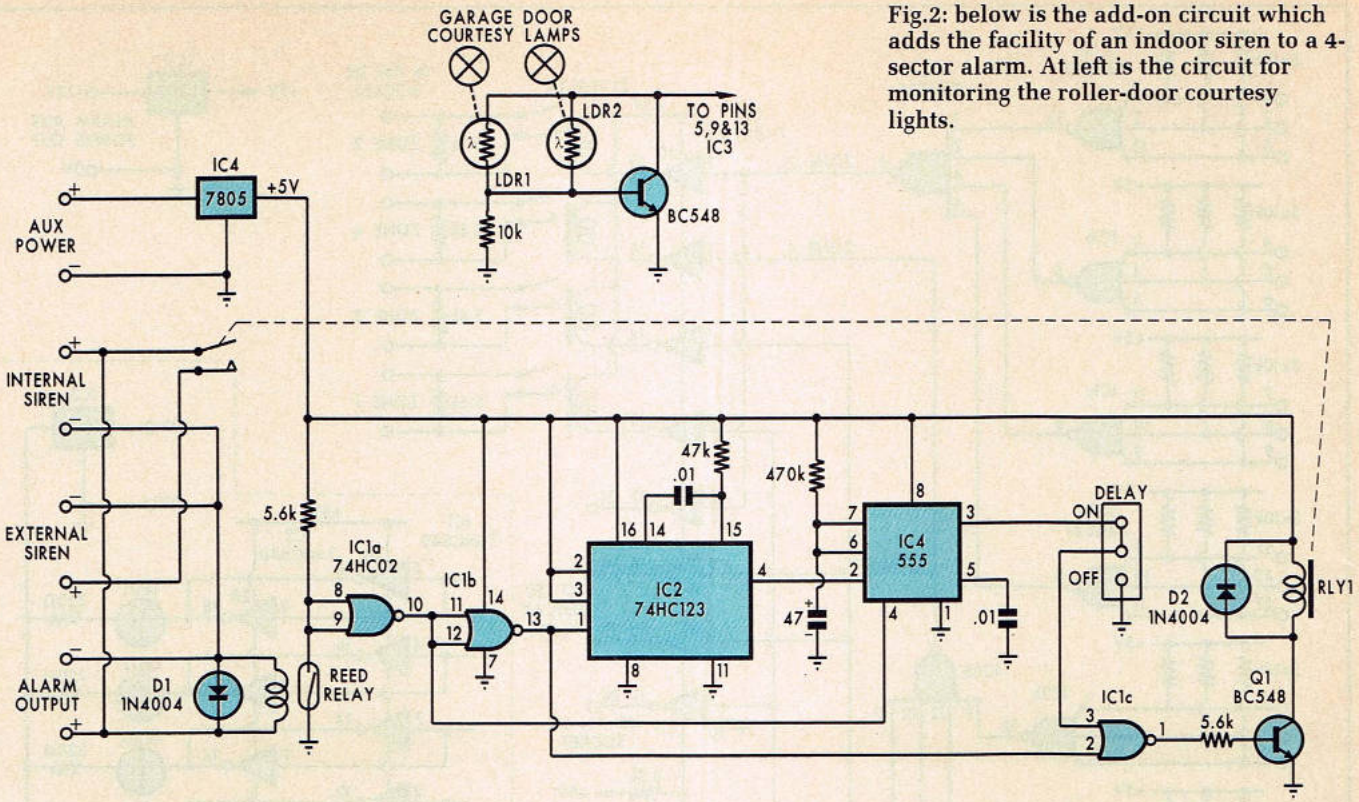


Fig.2: below is the add-on circuit which adds the facility of an indoor siren to a 4-sector alarm. At left is the circuit for monitoring the roller-door courtesy lights.

only minimal noise can be induced on the lines.

When the reed switch opens the associated input is pulled high by a 10kΩ resistor and this signal feeds through to IC8, a 74HC540 inverting octal Tri-state buffer, to drive one of the four sector relays. These relays control the 4-sector alarm referred to above.

Eight-wire Category 5 UTP twisted-pair data cable has been run for the inputs, with one pair of wires for each separate switch; one cable serves four separate switches.

Switch monitoring

To monitor every reed switch and sensor, there is a display panel next to the alarm keypad. The display has the house plan on it and LEDs are positioned where every switch is placed.

The total of 32 LEDs is driven by eight 74HC540 buffers. These can be arranged to turn the LEDs on or off, to represent the relevant circuit being open or closed, depending on the setting of four jumpers.

With the LED panel circuit powered, you can see at a glance which windows and doors are not shut before setting the alarm. This can also be useful on rainy days to check which windows are open or shut.

Of the four zones available, zones 1 and 2 are downstairs and zones 3 and 4 upstairs. Zone 4 is only used when the house is vacant. At night when the family retires, three of the four zones are armed.

With members of the family coming and going at all hours via the entry/exit door, it is a nuisance having to set and reset the alarm repeatedly.

This problem is overcome by the entry/exit delay circuit involving IC5a, IC5b, IC9 & IC10. This circuit allows the door to be left open for about 25 seconds before the alarm is triggered.

IC10, the 555 timer, provides the 25-second delay. Its pin 4 is held low by the reed switch when the door is closed.

When the reed switch opens, it allows pin 4 to go high and pin 1 of IC5a goes low to trigger the monostable IC9. In turn, this delivers a trigger pulse to IC10. Its pin 3 goes high for 25 seconds and then low, to provide the entry or exit delay.

Indoor siren

The circuit of Fig.2 provides an indoor siren facility. This prevents the external alarm from sounding if the house occupants inadvertently trigger the alarm by walking into one of the armed zones.

Instead, the internal siren sounds for about 25 seconds to allow the alarm to be disarmed. Depending on how the jumper at the output of IC4 is set, the circuit can be bypassed so that both inside and outside sirens go off together.

The circuit of Fig.2 works in a similar way to the entry/exit delay circuit described above. The alarm output of the 4-sector alarm is connected via a reed relay monitored by IC1a, connected as an inverter.

When the reed relay closes, IC1a & IC1b trigger the 74HC123 monostable and this triggers the 555 for 25 seconds to drive IC1c and transistor Q1 which then drives relay RLY1. Its normally closed contacts open the circuit to the external siren for the 25-second period.

The circuit is reset when the alarm is disarmed.

Garage entry/exit

The garage has two roller doors, each monitored with a reed switch and there is a PIR sensor to monitor the whole area. Pins 4, 9 and 12 of IC3 are connected to the roller door switches and PIR sensor.

Each roller door has a UHF remote control and the reed switches and PIR sensor must be disabled each time the

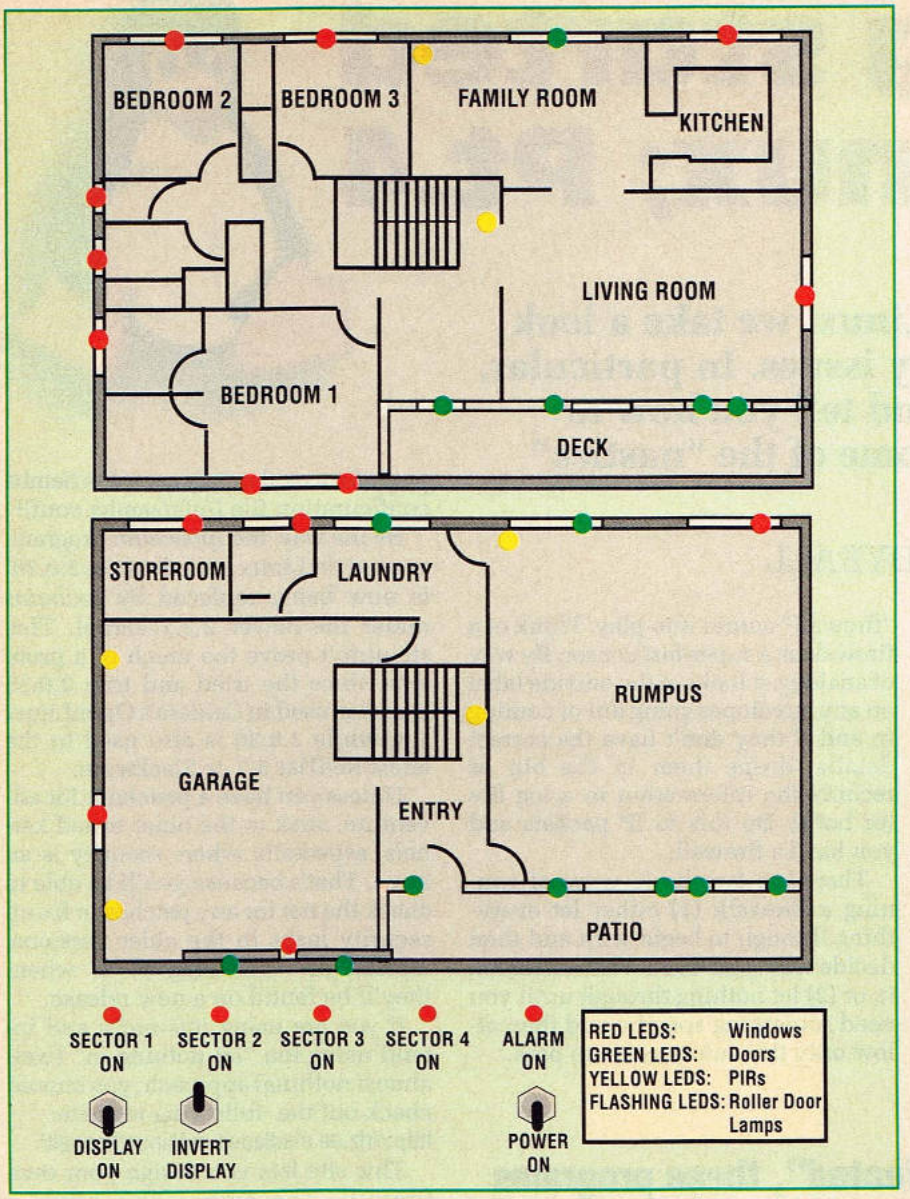


Fig.3: this alarm panel shows the plan of the 2-storey house. There are LEDs for every door or window being monitored.

remote controls are operated. This is done by monitoring the two lights fitted to each door that come on and stay on for a couple of minutes when the door is opened or closed with the remote control.

These lights are detected with a simple circuit containing two LDRs, a resistor and a transistor, which pulls the input pins 5, 9 and 13 of IC3 low.

While these are low, the output of IC3 is disabled so the alarm cannot be tripped while the roller door lights are on.

The LDRs must be shielded from external light so that daylight does not defeat the system.

When leaving the home by car, the procedure is to set the alarm, open the respective roller door with the key remote control, drive out and close the roller door by the remote control.

Then when the roller door lights go out, the garage is protected by the alarm. Manually opening the doors, if you get past the PIR sensor, will trip the alarm.

To provide an outside indicator, a LED and 2.2kΩ series resistor were connected to the programmed output of the 4-sector alarm.

This was programmed to come on when the alarm was set. Thus family members can see whether or not the alarm is set when they are leaving or arriving home. **SC**

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Getting started with Linux; Pt.4

In our final article on Linux, we take a look at firewalls and security issues. In particular, we describe the risks and tell you how to protect yourself from some of the "nasties" on the Internet.

By BOB DYBALL

Your local network IP addresses may be "invisible" to the Internet but that doesn't mean you're totally protected. There are still some important security issues to consider and this includes filtering both incoming and outgoing communications.

Although your network "packets" are protected to some extent by being non-routable, your network is still connected to the Internet via the router (see Pt.3). When a machine on the network accesses the Internet, packets of information for an outside address are first placed in a wrapper labelled 192.168.1.1 and sent to the gateway/router. The router then forwards the information to the correct address on the Internet.

Conversely, each time a response is received, the router passes it back to the correct machine on the network.

That's all very well but what if you would like to stop people (staff, children, students, etc) from playing Quake over the Internet and get them back to work? Is there a way of doing this but still allow them to use email or a web browser?

The answer to both these questions is "yes" and here we find that the "firewall" comes into play. Think of a firewall as a super-fast censor. By way of analogy, it looks at the outside label on any envelopes going out or coming in and if they don't have the correct details, drops them in the bin or records the information in a log file (or both). Do this to IP packets and you have a firewall.

There are two basic ways of running a firewall: (1) either let everything through to begin with and then decide what you don't want and block it; or (2) let nothing through until you need something specific and then allow only this information to pass.

Once your system is "infected", these programs can be used remotely by a third party connected to the Internet to read, write or delete files from your PC.

The first method has the advantage of being easy to set up and is probably the best approach for those implementing their first firewall. On the other hand, if you don't want to separately specify a block on IRC, Quake, DOOM or any number of other programs, the turn-everything-off-first approach is the best.

The latter approach can get rather complicated. On my own system, a relatively simple configuration file for *ipfswadm* – a firewall program for Linux – just fits on 20 printed A4 pages. This compares to just 2 or 3 A4 pages for a moderately complex Samba configuration file (/etc/samba.conf)!

By the way, the *ipfswadm* program, as used on Linux kernels up to 2.0.36, is now being replaced by *ipchains* under the newer 2.2.x kernel. This shouldn't prove too much of a problem, since the tried and true 2.0.35 kernel is used in Caldera's OpenLinux 1.3, while 2.0.36 is also used in the latest RedHat 5.2 or Slackware.

Unless you have a penchant for adventure, stick to the older tested kernels, especially where security is an issue. That's because you'll be able to check the net for any patches to fix up security leaks in the older versions, instead of wondering if, or when, they'll be found on a new release.

If you are using *ipfswadm* and intend using the "let nothing in" (well almost nothing) approach, you should check out the following website:
http://rlz.ne.mediaone.net/linux/firewall/

This site lets you design your own firewall. The author also offers a "home network" version of this great on-line configuration tool at no charge. You simply enter the details of your firewall requirements and it helps you set up an *ipfswadm* configuration file – called *rc.firewall* – to suit.

If you want to use *ipchains*, check:
http://www.rustcorp.com/linux/ipchains

This site includes the release itself, as well as documentation, version information and links to a number of other related firewall and security websites.

IP masquerading

IP Masquerading is another method of letting some packets through while denying access to others. Various preset packages for this are available with many current distributions. Similarly "binaries" (ie, pre-compiled program

files) for *ipchains*, along with the "how to" files, are available from various sources on the net.

Which ever way you go, be sure to check the version numbers. Some kernels will not work with various versions of *ipfswadm* or *ipchains*. If you want to find out how to use IP Masquerading, check for a text file entitled /doc/HOWTO/mini/IP-Masquerade (again, watch the case) on the CD-ROM for your Linux distribution.

Netbus & Back Orifice

Back Orifice (a pun on the Microsoft "Back Office" product range) and NetBus are both "Trojan horse" programs; ie, they appear to be something other than what they really are. Both can seriously compromise the security of your network and can allow a hacker to get up to all sorts of mischief. Usually, they are distributed disguised as a joke program and are often spread via email.

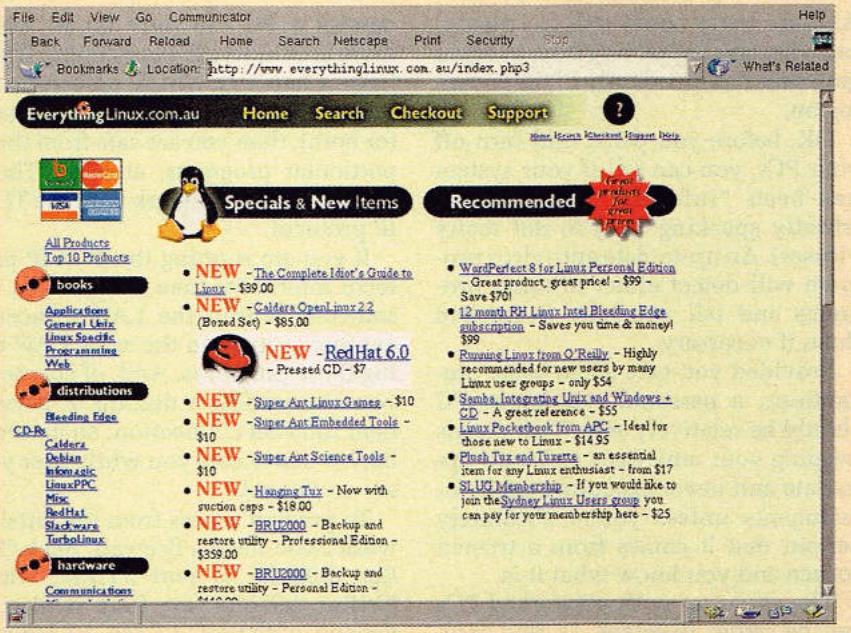
Not long back, it was the "Free Coke Tray" joke. This often appeared as a simple email attachment called *runme.exe* or some other appealing name. When clicked, it displayed a message asking "Do you want a free Coke tray" and, of course, when you answered yes, out popped the CD-ROM drawer.

The joke might have ended there but for the fact that this program has been used by some people to hide the NetBus or Back Orifice programs. Once your system is "infected", these programs can be used remotely by a third party connected to the Internet (they can be anywhere in the world) to read, write or delete files from your PC. They also have the ability to allow that person to "see" a screenshot of what you have on-line, to "see" what you type, to type in keyboard entries, to move the mouse pointer and to even display OK/cancel dialog boxes on your screen.

But that's not all. The person who releases these Trojan horses (and this might not be the person who gave it to you; they too might be a victim) can scan a block of IP addresses, waiting for one of their victims to go on-line. After that, it's only a short step to learning trade secrets, "borrowing" credit card details, or simply deleting files on the victim's computer just for the fun of it.

It wouldn't even matter if you were viewing a web page from a secure site.

Take a look at: www.everythinglinux.com.au


File Edit View Go Communicator Help
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books
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General Unix
Linux Specific
Programming
Web
distributions
Bleeding Edge
CD-Rs
Caldera
Debian
Infomagic
LinuxPPC
Misc
RedHat
Slackware
TurboLinux
hardware
Communications
NEW - The Complete Idiot's Guide to Linux - $39.00
NEW - Caldera OpenLinux 2.2 (Boxed Set) - $85.00
NEW - RedHat 6.0 - Pressed CD - $7
NEW - Super Ant Linux Games - $10
NEW - Super Ant Embedded Tools - $10
NEW - Super Ant Science Tools - $10
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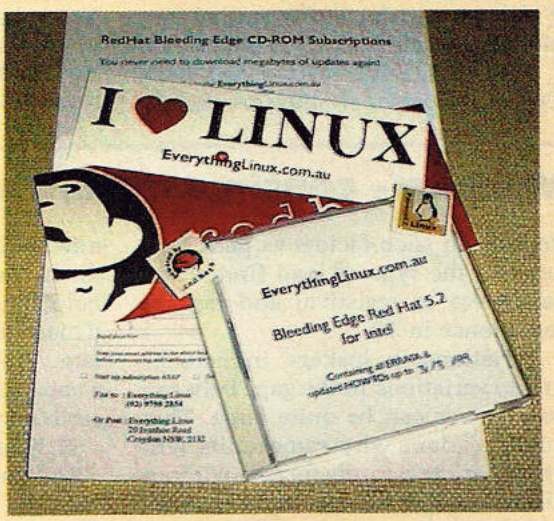

Linux is available from a lot more places than it used to be. Once you had to "troll" the net looking for Linux and spend interminable periods downloading the files. Having done that, you would then often find that a later version had already been released and was available somewhere else.

To overcome this problem, a number of software retailers are now selling boxed copies of Linux off-the-shelf, complete with manuals. No, it's not illegal and yes you have to pay but the price is usually less than $100.00. The GPL (or Gnu Public License) allows for books, support packages and so on to be added to the Linux package and sold together for a reasonable amount.

Note: sometimes the additions can be illegal to copy and distribute, as they are licensed for one person to use only. Many distributions can, however, be quite legally copied and *given* to your friends, so check the literature that came with your package carefully for copyright information.

This GPL license system allows companies like EverythingLinux to operate. This Australian company exists to sell and support Linux and offers a package called "Bleeding Edge Linux".

And it really is "bleeding edge" stuff. They burn the CD-ROM for you after you place an order, so that you get all the latest updates and drivers. The CD-ROM is self-booting and costs just $10 plus postage.

EverythingLinux also offers support packages for Linux (24 hours per day 7 days per week). Check out their website at:
www.everythinglinux.com.au
for all the details.

Getting started with Linux; Pt.4

Another party could still (in theory) see what was happening from a screen grab sent independently of the secure log on.

OK, before you panic and turn off your PCs, you can tell if your system has been "infected" fairly easily (strictly speaking, they're not really viruses). An up-to-date anti-virus program will detect either of these programs and tell you how to remove them if necessary.

Provided you take some basic precautions, a personal standalone PC should be relatively safe. That means keeping your anti-virus software up-to-date and never executing email attachments unless you're absolutely certain that it comes from a trusted source and you know what it is.

The situation with networked PCs can be rather different. In this case, it's all to easy for a disgruntled employee or student to infect a network.

Note that, with NetBus and Back Orifice, the person wishing to remotely control a PC can only do so while there is an active IP connection. If you have a network which only runs either the NetBeui or IPX/SPX protocols (or both), then you are safe from these particular programs, at least. That's because they only work with the TCP/IP protocol.

If you are running the TCP/IP protocol internally, then it's possible for someone within the LAN to access another system on the same LAN using these programs. And, of course, if you are running a dial-up or permanent Internet connection, an external hacker can access you while ever you are on the net.

To prevent access from the outside world, you need a firewall. Back Orifice defaults to port 31,337, while NetBus defaults vary from version to version, with ports 12,345, 12,346 and 12,331 being commonly used. Setting up blocks on the ports used by NetBus and Back Orifice will go a long way towards preventing problems but don't forget that it's quite possible for a program to use ports that are normally used for something else.

As an example, this technique is used legitimately by DCOM and CORBA on port 80, where you might normally use a web browser.

The Happy99.exe Trojan horse is another recent example of a program that works along these lines. It sends unwanted email with the Happy99.exe attachment though a conventional port but as far as a firewall is concerned, it "looks" the same as your email client. As with Netbus and Back Orifice, Happy99.exe can easily be detected by up-to-date anti-virus programs.

Achieving a happy balance between speed, security and access restrictions is not always that simple. At the very least, a log can alert you to peculiar activity. An early warning of unauthorised access will go a long way towards preventing problem people, either inside or outside your organisation, from causing real damage.

Acknowledgement: to Larry Ewing at lewing@isc.tamu.edu for the Linux penguin "Tux". SC

Mailbag – continued from page 27

depend on such factors as peak load current, the type of load (inductive, capacitive or resistive) and leakage inductance in T2.

Variations in leakage inductance due to variations in the gaps between core halves can be quite large. That might explain why some units will operate quite happily forever without distress, while others might consistently break down no matter how many times the transistors are replaced.

I would suggest fitting a 15V or 18V, 1W zener diode from gate to source of each Mosfet. A resistor of, say 47Ω in series with each of D5 and D6 might also be worthwhile (to reduce current surges through the zener diodes).

Sometimes feedback loop instability, due either to inadequate phase margin or to noise pick-up in the loop, can cause adverse effects such as double-pulsing of the main inverter transistors. This, in turn, can increase stresses in the transistors due to overheating or excessive voltage and current spikes.

An unstable loop can often be identified by strange squealing noises from a switching inverter. Placing a capacitor in the feedback loop will usually help, though it can make things worse if inadequate phase margin is the problem. A resistor (eg, 1kΩ) in series with a capacitor (eg, .001μF) from pin 1 to earth may help if instability persists.

H. Nacinovich,
Gulgong, NSW.

Compiler for the PIC microcontroller

After reading with great interest your PIC programmer featured in the March 1999 issue of SILICON CHIP, I have found a compiler for the PIC-16F84 microcontroller that does not require any knowledge of assembly code. It uses a high level language similar to C. The compiler has commands for Delay, LCD displays, RS232 communications and many other commands, making the PIC very simple to program.

The compiler is called JAL (Just Another Language). It comes with a number of examples and a fairly comprehensive manual and best of all, it is free. The web site can be found at http://www.xs4all.nl/~wf/wouter/pic/jal/index.html.

D. Chinnery,
Tom Price, WA.

Ventilation in cars

I note your comments in the article on the Carbon Monoxide Alarm in the May 1999 issue, where you suggest that car air conditioning be set to recirculation in heavy traffic. Please note that the current Ford Falcon AU model does not have flow-through ventilation. The lack of flow-through ventilation will permit the buildup of carbon dioxide. Mercedes Benz has a sophisticated system which vents the car at predetermined intervals but the system used by Ford is not as good.

I would suggest a dual model to monitor both carbon monoxide and carbon dioxide or alternatively, a separate carbon dioxide model. The greater number of vehicle passengers, the faster the carbon dioxide builds up.

I. Deal,
Melbourne, Vic.

Comment: while the suggestion to periodically vent the car is a good one, we do not know of any source for a carbon dioxide sensor. SC

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097.

Dolby Surround decoder is no more

I have an analog multimeter that is getting a bit old but it is still working. It has a 10A AC range. I also have a new 19-range digital multimeter but no AC amp range. Is there an add-on circuit I can make to get AC amps, like the DC current range up to 10A?

I am also upgrading my mono VCR to a stereo one. I was hoping to build the Dolby Pro-Logic from the November/December 1995 issues using the Jaycar kit but was told, by Jaycar in Auckland, NZ, that it is no longer made because of chip problems. Is this true? (L. I., Glenfield, NZ).

● It is possible to measure AC currents with your digital multimeter using the AC volts range. All you need is a suitable shunt rated at 10A and of a suitable resistance to generate a voltage which can be read by your multimeter. For example, if you use a 0.1Ω shunt, it will produce a voltage drop of 1V AC with 10A passing through it.

Jaycar have discontinued the Dolby Surround project but not because any chips are unreliable. The reason is simply that complete Home Theatre systems (which include Dolby Surround Sound decoding) from Yamaha, Philips and others are now so cheap that it is not worth building a kit.

Universal inverter wanted

Over the years I have become a great fan of some of your projects and have a number of them around my place. As I have no mains power and little money, your simple approach to such things like inverters has proved invaluable. I have built the inverter from the February 1992 issue of SILICON CHIP, with BUK456-60A Mosfets. I believe there is a need for a universal circuit that we can use to construct new inverters, as well as bring old units back to life.

I have found absolutely no problems with modified square wave (except in a few applications and there have been easy ways around them). We need a good voltage control. The low voltage cut-out is a nuisance; it always happens when I am in the middle of sending or receiving a fax or running the computer printer. The option of a buzzer coming on would be preferable.

An automatic start-up is all right for some of the bigger units. The ideal would be to have it on part of the board that can be broken off if not required.

The transformers are also too expensive for inverters. Is there a problem in just unwinding a few turns off a stock standard toroidal transformer for the 12V windings (that is, if we do not have an old inverter coil in the shed)? The voltage sensing could either be wound over the top of the existing windings or taken from a transformer out of a transistor radio connected across the output winding.

As far as the output is concerned, it would be great to be able to boost it up to any output up to 600W by just adding the right number of Mosfets to an appropriate transformer. Being able to make small inverters is just as important as these take less power to run and are very necessary to have alongside the bigger unit.

It is my opinion that it does not pay to have an inverter over 600W. If more power is required it pays to use a generator. You charge the batteries at the same time. All you are paying for with bigger inverters is extra batteries and generating capacity. People are getting quotes from $14,000 upwards to install an alternative system. Our community is doing it for less than $3000.

A bigger updated version of your February 1992 design with modified square wave, voltage sensing and voltage control using something like BUK456-60A switching would be something many of us would just love to have. We do not need things with bells and whistles on them; this can be left for the people who want to pay more than $14,000 and there are none of them around here. (R. B., Licola, Vic).

● It is possible to take turns off the secondary of 12V toroidal power transformers but it is hard work because the wire is generally so stiff.

Generally, it is not practical to produce a universal inverter with a rating up to around 600W. You will find that designing an inverter for a particular power range produces a much more

Engine performance monitoring

I'd like to see a project on engine performance monitoring for street cars.

I had a Ford Fairmont with a fuel economy trip computer and I'd like to build one but I can't find a device to measure fuel flow. There are plenty available for the marine industry but I can't find one with a low enough scale to suit an ordinary street car.

An ordinary street car burns about 12 litres per hour (200ml/minute) on the highway but the marine devices start at about 1l/minute, ranging up to 100l/minute. I know one of the Australian electronics magazines did a project on one some time in the last 20 years but I can't find it.

Can you help? (C. R., Cairns, Qld).

● We don't know of any cheap fuel sensors for car computers. Perhaps you could obtain one from a car wrecker.

On the other hand, if your car has fuel injection, it is possible to monitor fuel flow by measuring the duty cycle of the signal fed to the injectors.

Our fuel monitor project, published in August 1995, used this principle.

Interference in TV pattern generator

Can you advise please whether any modifications or improvements have been published for the TV Pattern Generator, as described in the June & July 1997 issues? My kit selects and displays all the modes satisfactorily but some modes are flawed by weak superimposed unstable patterns.

Interference is particularly noticeable on the white raster; less so on the red raster. On some TV sets it is possible to count 18 weak unstable narrow vertical rope-like stripes on the white raster. What appears to be a weak blanking pulse also drifts slowly down the screen.

On the crosshatch display every vertical line is displaced slightly, in a slow cyclical fashion, from top to bottom of raster. The colour bar display is stable but the transition between bars is less sharp than I expected. These effects are less noticeable if the TV set brightness is reduced below normal.

The kit's 5V rail is clean; the 12V rail has less than 10mV of noise and all chip waveforms are clean and stable. Blanking and sync waveforms going to the colour-encoder chip seem normal.

Extra earthing of the chip negative rails does nothing. Earthing the sound input of the LM3850 RF modulator also does nothing. I suspect the problem may be due to the PC board groundplane layout and that the interference may be common to all kits. It may even be due to interference from the TV set connected to the pattern generator.

Any help you can offer to reduce this minor but annoying effect would be very much appreciated. (C. H., Hughes, ACT).

● The problem you are having with the TV Pattern Generator is not common to our knowledge and there have been hundreds of these projects built.

If possible, it would be wise to test the TV Pattern Generator using the direct video output. You can either connect the video output to the TV set directly if it has this facility or connect it to a VCR. Select AV on the VCR and then tune the TV set to the VCR's RF output channel.

If the patterns are now clear of all the interference and wavy lines, you can assume that the modulator within the Pattern Generator is giving a low output. You can increase the modulator output simply by shorting out the 470µF capacitor between the wiper of VR2 and the video input to the modulator. This will prevent video signals going below ground to allow more modulation depth.

Also, it is important to set the video level using VR2 to obtain the best picture. Make sure that you are using a 5V supply for the Jaycar modulator rather than the 12V fed by a 180Ω resistor.

efficient circuit in terms of current drain.

Cables for video projector

I have finally finished building my complete home theatre surround sound system based on your early Dolby Pro-Logic Decoder which I built into a 2U 19-inch rack case, a better choice than the plastic case supplied with the original project back in December 1994. Apart from the obvious screening benefits of a metal case, it looks great. This decoder is teamed up with a separate preamplifier and power amplifier combo, which contains no less than five of the 115W RMS modules you presented in April 1996. This power amplifier combo will also be used later for Dolby digital.

The whole system was mounted in a modular rack frame supplied by Altronics. For the subwoofer, I built a bandpass enclosure with a 12-inch driver. The power amplifier module and filter used to drive this speaker was also mounted in the enclosure. A complete module designed for this purpose is sold by Jaycar Electronics. It has auto on/off, high and low audio inputs and over 150W of sheer grunt. My friends who have heard my system describe it as awesome.

As a final touch to my system, I mounted two electromagnetic transducers (also sold by Jaycar) in my lounge chair and supplied them from the subwoofer amplifier. When I turned them on the first time, I was watching Star Trek Deep Space Nine and a battle with the Jem'Hadar. I had to hang on for grim death as Photon Torpedos were exploding all around me and shaking my chair and everything else for that matter, to pieces. After that experience, an action move would not be the same without them turned on.

My latest addition to the system is a video projector manufactured by Mitsubishi (model LVP-X100A). I plan to mount this off the ceiling above the seating area. The distance between the projector and the VCR is over 15 metres. My question is what kind of cable should I use to connect them together? The projector and the VCR use RCA connectors; yellow for video signal and white and red for the stereo audio signal.

I have been led to believe that outputs from video recorders were 75Ω impedance so using a good coaxial cable would be a better choice, especially over a long distance. Could you please advise me? Also, is there a video signal amplifier I could use to make up any loss in signal over that distance? (K. S., Morphett Vale, SA).

● Your home theatre sound system sounds really impressive. With the addition of a video projector you'll never want to go to the cinema again, (unless you want to see Imax).

Your video projector should be able to drive about 20 metres of cable but it must be good quality 75Ω coax. Typically, it should be at least 6mm in diameter and with a foam core.

Spacewriter letters are squashed

I built the Spacewriter described in the May 1997 issue. I have one problem in that the first characters of the message appear squashed. This is happening because the delay adjusting trimpot VR2 is only working at its higher side. When I try to increase the delay time by adjusting VR2 anticlockwise, all the LEDs stop working. Please help me to solve problem. (Farid – via email).

● The characters will appear to be squashed up at the left if the delay time is too short, as set by VR2. If the delay is set to its minimum position you may not "see" any characters since the message will have passed before the Spacewriter is swung. Try adjusting VR2 fully clockwise to obtain the maximum delay. Then adjust the rate trimpot VR1 so that you can see the display as the Spacewriter is swung from side to side. Adjust VR2 for best results with regard to the compression of the character at the start of the swing.

There is also some practice required to obtain the best display. You may find that your technique is unsatisfactory for the values of delay and rate. The rate can be changed either by decreasing the .068µF capacitor at pins 2 & 6 of IC2 for a faster rate or increasing the value for a slower overall rate.

The delay can be changed by increasing the 1µF capacitor at pins 5 & 6 of IC5d.

Power amplifier ratings

Your power amplifier described in the August, September & October 1997 issues is rated at 500W into 4Ω and 278W into 8Ω, but has a music power rating of 590W into 4Ω and 315W into 8Ω. What is the difference between output power and music power? (Jason - via email).

● The rated output power is the continuous or RMS power output. The "music" power is the power available in short bursts, in this case for 20ms bursts, as outlined in the American IHF standard. We featured a major article on music power, amplifier headroom and related subjects in the July 1988 issue.

Rolling code transmitters

I have read your articles on remote garage door openers in the April & May 1998 issues and was very interested. I have just been given an old B&D door opener but I'm concerned about new scanning and code grabbing equipment on the market. Do you have a project in one of your issues that's a remote control unit which prevents code grabbing and scanning. (Steve – via email).

● We don't have a rolling code UHF transmitter. If you want to avoid the possibility of scanning, you might consider using an infrared controller or a UHF transmitter with a very restricted range.

Waa-waa pot pedal travel

I've just finished making the Waa-Waa pedal as described in the September 1998 issue and I was wondering about the slider pot. I get an effect from sliding the pot only the first little bit, about a quarter the full length (it's a 50kΩ slider pot), then from there to the end it seems to do nothing, which doesn't seem right. I also get a strange hiss which, while it's not that strong, is still noticeable while it's in the "on" mode. What can I do to fix it? (Luke – via email).

● The fact that you are obtaining a satisfactory effect over a small portion of the pot range suggests that the problem could be one of two things. First, check that the slider pot is a linear type. You can easily check this by measuring the voltage at the wiper of the pot with respect to the ground. The voltage should rise smoothly from 0V up to 10V as the slider is moved over its range. The voltage should be about 5V at half setting.

If the voltage rises quickly from 0V to near 10V in only a short movement of the pot, you can suspect that it is a log type. Logarithmic pots are nowadays labelled with an "A" while linear pots are labelled with a "B".

The second problem could be that the frequency of operation is too high so that the Waa-Waa effect is operating from well above 50Hz and beyond 2kHz. This could also explain the lack of effect after the pot value reaches the 25% position. Check the value of the capacitor between pins 6 & 7 of IC3 and the resistors at pins 11 & 12.

Note that trimmer VC1 should be adjusted for minimum noise output when the pot (ie, the Waa-Waa pedal) is in the open position. In other words, pin 9 of IC3 should be at 0V and VC1 is adjusted so that the output noise is acceptable.

High current 13.8V supply wanted

You presented a revised 40V 8A power supply in the April & May 1998 issues of SILICON CHIP. This new design prompted me to consider a similar review of the 13.8V 25A transceiver power supply of May & June 1991. Is it probable that you will develop a new protected high-current 13.8V switching power supply, or if not, what modifications to the April 1998 design would render it suitable for this purpose and what maximum continuous current output could be expected? (D. B., Regents Park, NSW).

● It is not possible to modify the 40V 8A power supply to deliver 13.8V at 25A. While the overall power levels may be roughly the same, in practice, the much higher current means that you would need a complete re-design. We still regard the 13.8V 25A supply as a valid design and don't have any plans to upgrade it.

Misfiring with the multi-spark CDI

I am writing about your Multi-Spark CDI system, as described in the September 1997 issue of SILICON CHIP. I have built two of these units for my 1965 6-cylinder Chevrolet Nova, one of which works perfectly. The other works perfectly up to 1000 RPM but refuses to go above 1500 RPM; the motor just splutters. Do you have any ideas? I had to change the .033µF capacitor across the MJE340 to .0047µF, to get my tacho to work.

Also, my Kenwood mixer uses a thyristeron (2N6347 or 2N6395). Can you tell me what a thyristeron is and how it works?

I have an AM/FM radio which uses only one single IC apart from capacitors and resistors. Can you please tell me what this chip is called and where to get one? (R. J., El Arish, Qld).

● Assuming that your CDI is delivering 300V to the dump capacitor when the motor is otherwise dying, it seems as though you have a problem with the trigger circuit. Do you have the right value for C3 (values shown on circuit) and is it soldered properly into place?

Shift indicator for cars

Can you tell me how to convert the Gear Change Indicator published in the September 1998 issue to take a signal from the distributor or tachometer input. Is it possible to feed the signal from the distributor straight into the board? (A. S., via email).

● The circuit can be modified to operate from a low voltage signal from the ignition system by altering two capacitor values. Change the 0.1µF capacitor at pin 2 of IC1 to .033µF and the 10µF capacitor at pin 4 to 2.2µF. Pin 11 must be biased to half-supply by connecting a 10kΩ resistor from this pin to the +5V rail. The 470Ω resistor between pins 1 & 11 should be removed. Also change the 100Ω resistor at pin 1 to 10kΩ and remove the .001µF capacitor. Connect a 4.7V zener diode between pin 1 and ground to limit high voltages to the pin 1 input.

The circuit can then operate from a 12V signal which is triggered by engine rpm and is applied to the pin 1 input via the 10kΩ resistor. Note that the input is not suited to the high voltage from the ignition coil primary or at the points.

You can also use the input circuit featured in the 5-Digit Tachometer described in the October issue of SILICON CHIP. This will handle the high voltages from the coil and also filter the signal. Use the 22kΩ & 10kΩ divider, the .056µF capacitor followed by the 1µF coupling capacitor and 10kΩ pull-down resistor. The signal from the 1µF capacitor can then be applied to the revised Gear Change Indicator input.

Your Kenwood mixer actually uses a thyristor, also known as a Silicon Controlled Rectifier (SCR). Its speed control circuit is similar to one we published in the September & November 1992 issues.

We are unable to help you with the IC identification but there are quite a few of these which are produced in Asia.

Adjusting the Railpower Mk.II

I have been operating the RailPower Mk.II (September & October 1995) on a rather large model railway layout for some time now, and find it extremely reliable and powerful. My query is can the speed rise time be adjusted to rise in less time than the design setting? (Don - via email).

● On page 43 of the September 1995 issue we state that "the inertia setting controls the time the train takes to accelerate from zero to maximum speed. This adjustment can range from zero to four minutes.

On page 39 of the October 1995 issue under "Calibration" we mention that the pots (including inertia) may need adjusting several times to get the desired results. In other words, having gone through the testing procedure, you then need to adjust the inertia pot several times to get the result you want.

Increasing turbo cool-down time

I have a question about the Turbo Timer featured in the November 1998 issue of SILICON CHIP. The article says that it leaves the engine running for 90 seconds. I was wondering how to increase that to 3 minutes. Also, is there any way of making the engine stall if the accelerator is pressed when the keys are out and turbo timer running? (Raphael - via email).

● You can increase the timer period by increasing the 390kΩ resistor to 820kΩ. If you want your car to stall when someone pushes the accelerator, you need to install the Engine Immobiliser described in the December 1998 issue and rig it up to a switch operated by the accelerator pedal.

Temperature gauge for Go-Kart

I want to make a temperature gauge for Go-Kart. The device would be used to assist in tuning the 2-stroke engine, by monitoring the temperature of the exhaust gases. The temperature range required to measure is between 950°F and 1150°F.

Units that do just this are available but cost $320.00 and frankly I can't see how they could cost so much to make. They use a series of LEDs to indicate temperature. Could this be done using a K-type thermocouple (as used with their device) and a millivoltmeter of some sort. Compensation for ambient temperature is not necessary, however the response time of the device has to be very short (W. M., via email).

● We published a thermocouple adaptor for DMMs in the December 1998 issue but this circuit is limited to 600°C which is equivalent to 1112°F. If you are tuning an engine, perhaps you might also consider employing an oxygen sensor (suitable only for unleaded fuel). We published a mixture meter circuit using an oxygen sensor in the November 1995 issue.

Expander box for audio inputs

As the owner of a great Pro-Logic hifi system I have only one complaint: it has only one auxiliary input. With most forms of entertainment systems today being infrared remote controlled, having to get up to change from one input to another (even through a switch box) is most inconvenient, especially for people who are handicapped. I would like a remote-controlled Expander Box with up to four inputs and one output to go to the Aux input of a stereo system. (D. G., Woodridge, Qld).

● While we have not published a project which suits your exact requirements, it would be reasonably straightforward to adapt the 8-channel remote control circuit featured in the February 1996 issue of SILICON CHIP. It used relays for switching.

Programmable ignition connections

I have made your Programmable Ignition system together with the high capacity CDI and the knock sensor kit. I have two main questions which the kit seller can't answer. Where should the coil connection to the knock sensor go? If it goes to the coil, won't it get misleading information from the Multi-Spark CDI? What happens to the LED display on the knock sensor as there appears to now be no output from the LM311 comparator to

pin 5 of IC2 LM3914? (S. S., Adelaide, SA).

● The knock sensor should operate on the Multi-Spark CDI if the ignition coil input is altered to handle the higher voltages. This would involve using 1W resistors for the 15kΩ values connecting to pin 6 of IC1d.

An alternative method of driving the knock sensor would be to use the ignition coil input from the tacho meter signal on the Multi-Spark CDI. Unfortunately, the signal will need to be inverted using another common-emitter amplifier in a similar arrangement to Q5. Connect a 10kΩ resistor from the collector of Q5 to the base of another BC337 transistor. Connects its emitter to ground and the collector to the 12V supply via a 10kΩ resistor. The collector output will be an inverted tachometer signal suitable for driving the ignition coil input of the knock sensor.

Remote control extender not happy with Mitsubishi

I have built up three of your IR Remote Control Extenders, as described in the July 1996 issue of SILICON CHIP. I have found them to be very useful in most applications. However, when I use one of these units for controlling Mitsubishi TVs or VCRs then the only way they will work is if the actual remote control is within 1cm of the IR extender.

I suspect the IR receiver in the circuit does not have sufficient bandwidth and/or sensitivity for the Mitsubishi units. Are you able to help by recommending a circuit modification or by suggesting a better IR detector which I could use? (G. T., via email).

● We don't have any information on this problem. Does anyone know of a solution?

Converting the insulation tester

A few years ago I built the Insulation Tester described in the May 1996 issue but have not found it very useful as the minimum resistance it measures is 1.4GΩ. A reading of less than this implies a fault but in fact the AS3100 requires a resistance of >1MΩ so a reading of <1GΩ may be still be well within the standard.

It was therefore with interest that I saw the article detailing a Megohm Tester in the January 1999 issue. I noted that there were some similarities between the two circuits and wondered if it would be possible to convert the older design to read in MΩ instead of GΩ. Is it possible, without great effort or expense, to do this conversion and if so, could you please tell me how? (D. R.,, Mansfield, Vic).

● As you have noted, the circuits are quite similar in principle. They differ only in the impedance of the leakage testing circuit. To make your Insulation Tester read in Megohms you need to replace the circuitry involving IC4 and IC5 with that involving IC2b and IC3b in the Megohm Tester.

It would not be necessary to change the op amps as the CA3140s can perform exactly the same function as IC2b and IC3 in the Megohm Tester circuit. The LM3915 circuits in both testers are identical.

LED ammeter green LED always on

I have a problem with the LED Ammeter described in the January 1999 issue of SILICON CHIP. Everything is fine with the circuit apart from the extreme RHS green LED being continuously on after power up. No amount of adjusting VR2 can change this.

I have replaced IC1 but it made no difference. I also noted that the 10µF electrolytic capacitor's positive electrode is connected to D1 in the overlay diagram but is connected to pin 4 of IC1 in the schematic. I oriented the capacitor this way but still no difference was evident. (N. P., via email).

● The 10µF capacitor should have its negative electrode connected to pin 4. The circuit diagram is wrong. Thanks for bringing this to our attention. As far as LED1 is concerned, when pin 5 of IC2 is at 0V, LED1 should be off. Adjust VR2 to get 0V at pin 5 of IC2. You can check this with your multimeter. Also check that -5V is present at pin 4 of IC1.

Notes & Errata

Digital Capacitance Meter, February 1999: On the circuit diagram on page 68, trimpot VR4 should be connected to the +5V rail, not 0V. This is correctly shown on the wiring diagram on page 70. Also, on the circuit, the resistor between pins 5 & 6 of IC1b is shown as 20kΩ but appears as 22kΩ on the wiring diagram; either value will work.

Command Control Encoder, February 1998: Under some circuit conditions, the buffer involving op amp IC8a may act as an inverter and this upsets the circuit operation. To avoid this, connect a 1MΩ resistor between the +12V rail and pin 3 of IC8. No other circuit changes are necessary.

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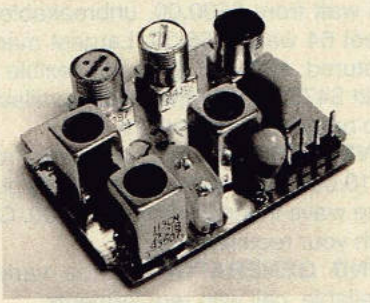

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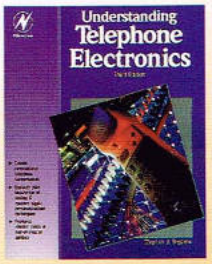

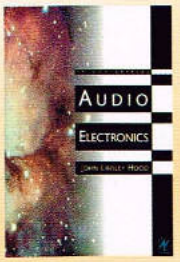

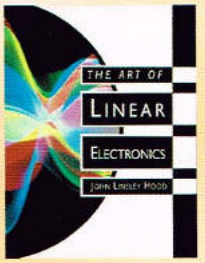

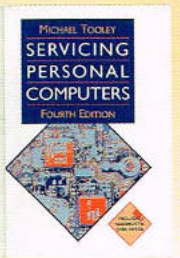

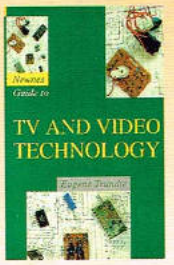

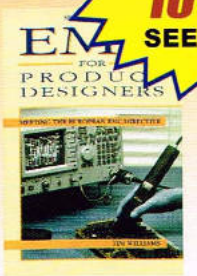

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